

# NATIONAL GEOGRAPHIC

## THE TALLEST TREES

REDWOODS

ROCKETING WHALES 64

INDONESIA FACES THE FANATICS 76

LOST IN THE SAHARA 100


A PRICELESS SHIPWRECK 116

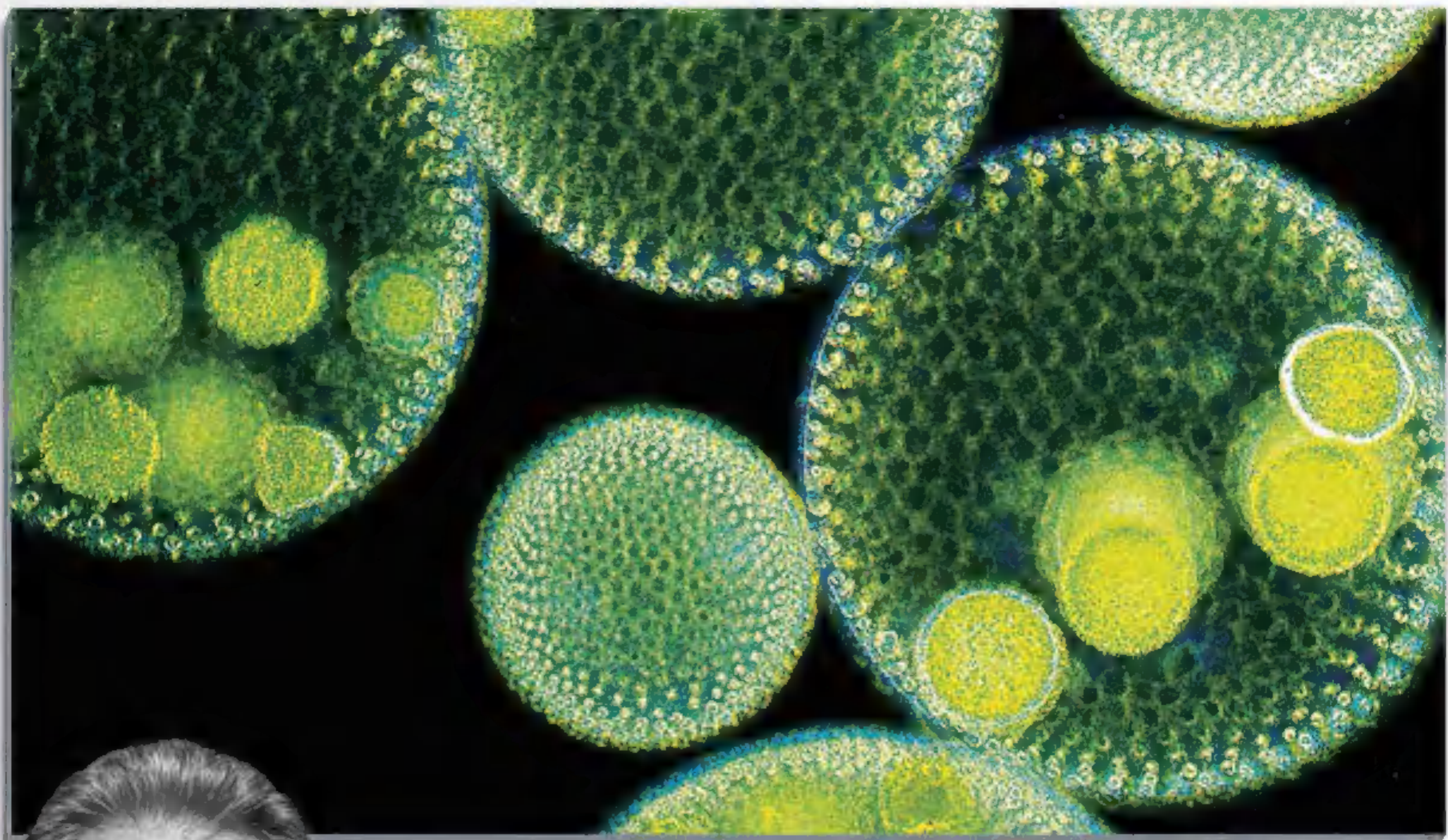


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# NATIONAL GEOGRAPHIC

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- Redwoods: Super Trees** **28** Explorer Mike Fay hiked 1,800 miles to save the forest.  
*By Joel K. Bourne, Jr. Photographs by Michael Nichols*
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*By Michael Finkel Photographs by James Nachtwey*
- Unseen Sahara** **100** In the wet past, hunters, farmers, even elephants lived there.  
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- Treasured Ship** **116** It sank in 1533. Now it's been found, full of gold and history.  
*By Roff Smith Photographs by Amy Toensing Art by Jon Foster*



Pilgrims head to security in an Indonesian terminal for flights to Mecca. The Saudi Ministry of Hajj insists on well-labeled bags. Story on page 76.

JAMES NACHTWEY

# NATIONAL GEOGRAPHIC

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If you think a marathon is too easy, try a 125-mile race. In the desert.

### TECHNOLOGY

#### Fastest Car

The Bloodhound SSC should go faster than a speeding bullet.

### CULTURE

#### Pumped-Up Pumpkins

Growers are aiming for a 2,000-pounder.

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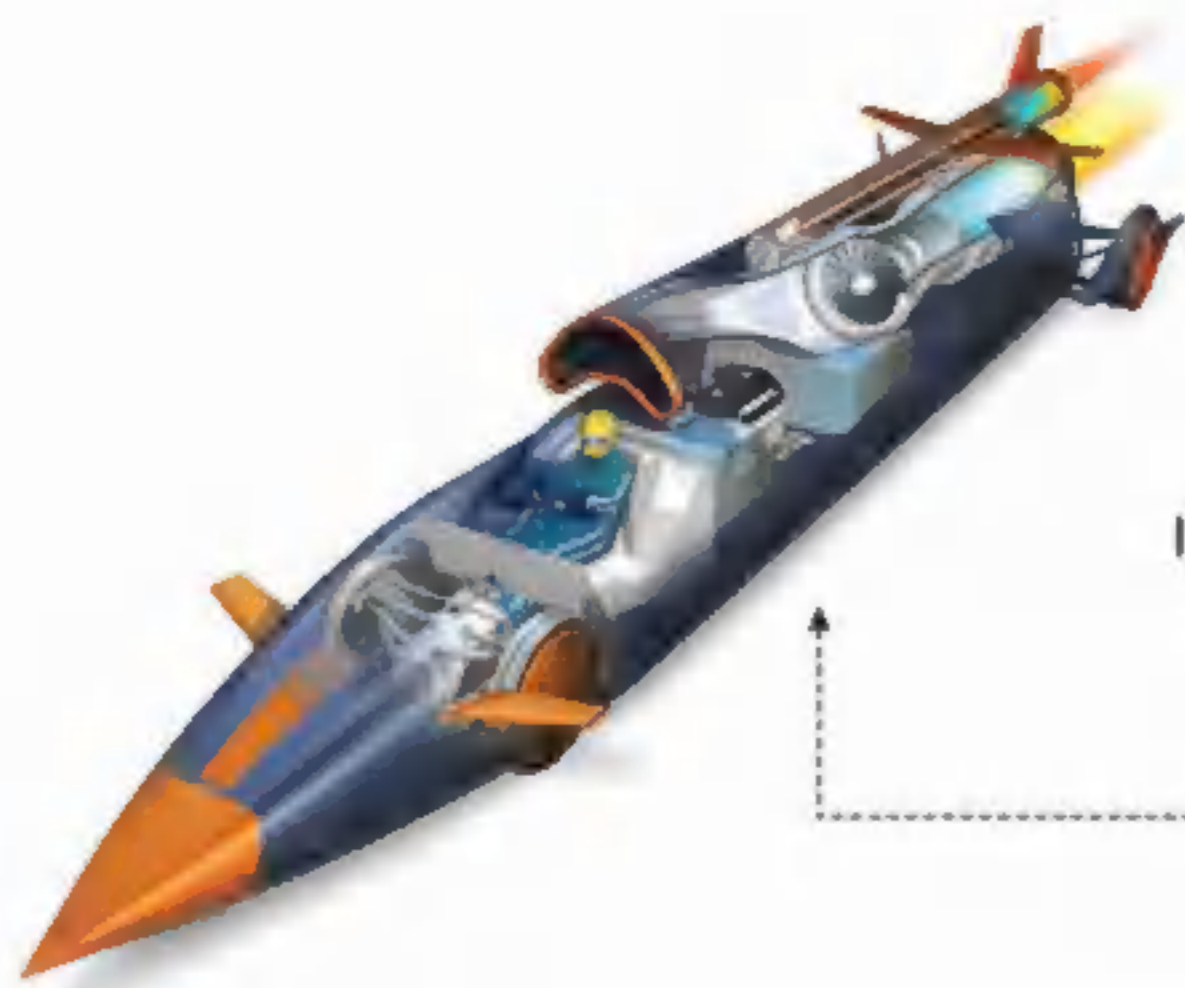
**Flashback**

**GeoPuzzle**

### On the Cover

It's part of a portrait made up of 84 shots, taken as cameras rode a rope rigged by canopy ecologist Jim C. Spickler.

*Composite image by Michael Nichols*



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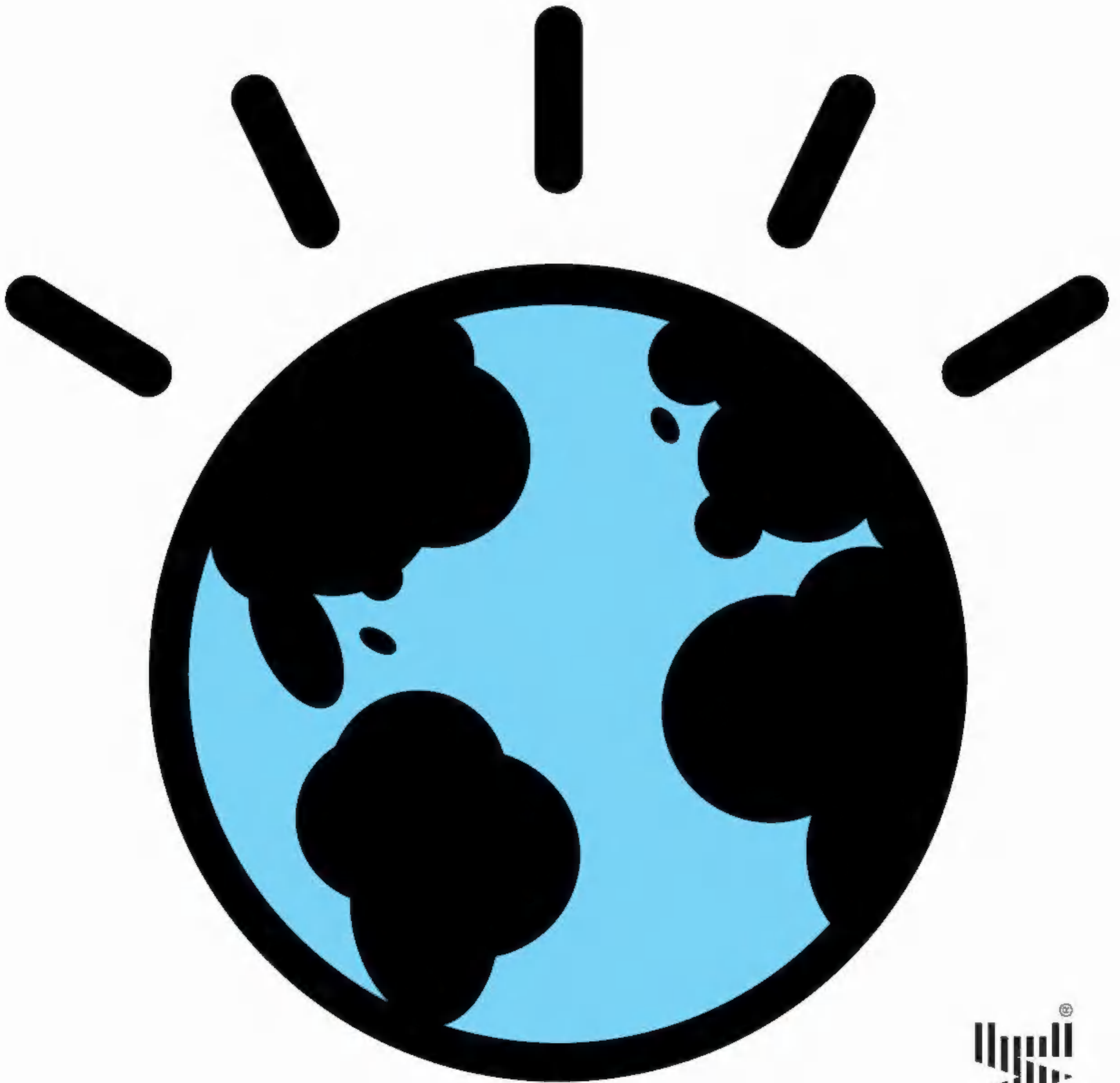
#### Tree Pedigree

The world's tallest trees are also among the world's oldest.

Our interactive time line traces the past on the rings of one redwood from California.

PAUL ZAHL

On a smarter planet,  
the question isn't what can we do.  
The question is what will we do?  
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Fog blurs the treetops in the Lady Bird Johnson Grove of California's Redwood National Park.

**Lying on a soft,** damp forest floor, looking up and oblivious of time, I'm in one of the most magical places on Earth, Jedediah Smith Redwoods State Park in northern California. I can hear the panic in my mother's voice as she searches for me—her ten-year-old who has a habit of disappearing in the woods. I should shout out to put her at ease, but not just yet. I want a few more minutes of solitude with the tallest trees I've ever seen.

Six years later, I'm lying on a hard, dusty plywood floor in a house under construction. It's lunchtime on my summer job; I'm resting with my fellow carpenters and looking up at a new redwood ceiling. The beams and boards are stunning, a perfect illustration of why this wood is so coveted and why so many redwood forests are leveled.

In this month's issue you'll meet others who share my fascination with redwoods. Biologist Mike Fay and his hiking partner, Lindsey Holm, spent a year walking and studying the redwood ecosystem from south to north. Joel Bourne writes about their journey and examines the controversies surrounding redwoods, trees with which National Geographic has had a long association.

"California revolutionized the world with the silicon chip," says Fay. "They could do the same with forest management." Could it be that Fay, who's spent decades advocating for African forests, has found the solution to management in the very state he calls home? We hope so.





**Southern Cassowary** (*Casuarius casuarius*)

**Size:** Head and body length, 102 - 170 cm (40.2 - 67 inches) **Weight:** 29.2 - 58.5 kg (64.4 - 129 lbs)

**Habitat:** Prefers rainforests, but will also use savanna forests, mangroves and fruit plantations

**Surviving number:** Estimated at 10,000 - 20,000



*Photographed by Kevin Schafer*

# WILDLIFE AS CANON SEES IT

Why fly? Able to run at speeds exceeding 30 miles per hour and swim expertly, the southern cassowary gets around very well despite being flightless. The solitary bird announces its presence with loud, deep booms that carry remarkably far through the foliage. During breeding season, females mate with one to three males, starting a new nest with each partner, who then incubates the eggs and cares for the chicks. But this cycle of life is being seriously

upset by habitat fragmentation, introduced predators, collisions with vehicles, and hunting. Quick though it is, the southern cassowary cannot outdistance these deadly threats.

As we see it, we can help make the world a better place. Raising awareness of endangered species is just one of the ways we at Canon are taking action—for the good of the planet we call home. Visit [canon.com/environment](http://canon.com/environment) to learn more.

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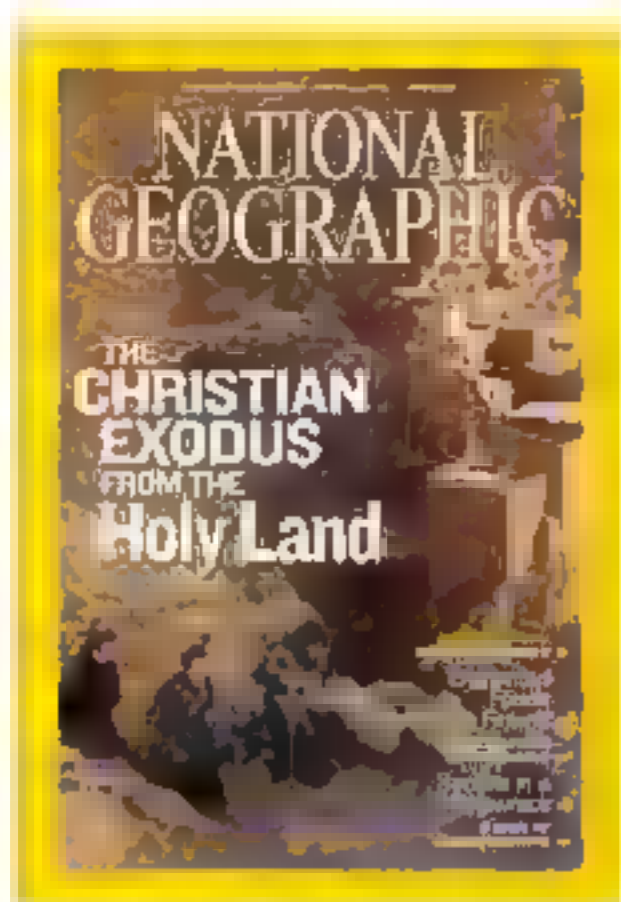
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June 2009

## The Forgotten Faithful

I have been covering the Middle East for more than 40 years [the writer is currently a columnist for the Huffington Post] and have written often about the growing plight of the region's Christian communities. I was therefore disturbed by the distorted cover story on the tragedy. Author Don Belt is wrong: Christian difficulties in the Arab world did not commence with the Crusades but rather with the birth of Islam itself. Muhammad's faith has always rejected other faiths. The Prophet's followers preached that "people of the book"—Jews and Christians—could be tolerated as second-class, subjugated dhimmis. But they were never granted equality under Islamic rule. And over the centuries that preceded the Crusades, communities of Jews and Christians were periodically forced into conversion. Second, while the Arab-Israeli conflict continues to overheat the regional atmosphere, the real pressure on Palestinian Christian Arabs—as well as Lebanon, Syria, and Iraq—stems from the heightened power and pressures of radical Islamic

groups, not from Israeli or American policy. In Palestine, Islamist thugs regularly force Christians to sell them their land and businesses—or simply seize them. No one doubts that Israel's security fence/wall causes hardships for Palestinians—both Christian and Muslim. But nowhere does Belt explain that the divider exists as the direct result of Palestinian terrorism. Nor does he point out another fact: While Christian communities in the Arab world continue to disappear (the Christian population of Bethlehem has gone from 90 percent to less than 25 percent; of Lebanon, from 60 percent to 27 percent), the only place in the Middle East where Christian communities are expanding is in the Jewish state of Israel, where since 1949, the number of Israeli Arab Christians has grown by an astonishing 345 percent!

**RICHARD Z. CHESNOFF**  
New York, New York

*Author Don Belt responds: When Richard Chesnoff notes that Arab Christian numbers inside Israel have grown "an astonishing 345 percent" since 1949, he includes many thousands of non-Arab Christians who have emigrated from Russia since the 1980s. Israel's indigenous Christian population, while showing a natural increase, has in fact dropped from 2.9 percent of the total Israeli population to 1.7 percent, according to the 2008 Statistical Abstract of Israel. He also blames radical Islam for the modern exodus of Christians from the Palestinian territories. My reporting indicates otherwise. In a recent survey of West Bank Christians by sociologist Bernard Sabella of Bethlehem University,*

*only 7 percent of respondents cited religious extremism as a reason for leaving, compared with lack of economic opportunity (39 percent), emigration/Jewish settlement (23 percent), and lack of housing (19 percent).*

I'm ■ Palestinian and have lived all my life in Bethlehem. My family includes my wife and five children. I live in one apartment in a house that was on a major road before they built the separation wall. After 2002 the wall closed the road to traffic and tourists who might buy anything. I had ■ small shop. My shop closed, and my business died. There was no income for my family. The worst part has been the psychological impact on my children. I don't want to leave my house. It is a part of my life. For years I had my successful business. When the wall was built, it separated our home and business from Rachel's Tomb. This started the suffering. Thank you for the article, which tells the world that there are Christians in the Holy Land. Somehow seeing this article gives us hope.

**GEORGE ANASTAS**  
Bethlehem, West Bank

## Corrections, Clarifications

### June 2009:

Page 10: Stanisław Jawor's Your Shot photograph does not show a setting moon. It is a predawn rising moon.

Pages 12-13: The tornado shown in Visions of Earth is incorrectly described as backlit.

Page 77: The correct location of the falls pictured is the Jyrävä River.

Page 130: Marion Smith's age is 67.

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## LETTERS

I truly feel this article was biased against Islam. To blame Muslim Arabs in the Middle East for the exodus of Arab Christians is to ignore Israel. There is barely a mention of this. Scholarly evidence points to Israel as a source of exodus of all peoples in the Levant crescent. No Muslims are targeting Christians in Palestine. These people—Muslim or Christian—are the victims of Israel, period. Also, any good scholar who mentions the brutal Christian Crusades would mention Salah al-Din, a Muslim who kicked out the crusaders. He also returned the battered Jews, Muslims, and Christians and restored their places of

worship. Salah al-Din made sure all three religions were protected. That makes me, as a Muslim, proud. And he only did what Islam taught him to do.

**TINA ISSA**  
Chicago, Illinois

The position of Palestinian Christians in the West Bank has declined rapidly since the PLO took over. Corruption and lawlessness under the Palestinian Authority make opportunities elsewhere more attractive. Of course the Arab-Israeli conflict does not help, but Palestinian Christians are increasingly marginalized and intimidated by neighbors. They can blame Israel because Israel won't

retaliate for criticism. Other Palestinians will. Elsewhere in the Middle East, the plight of Copts and Chaldean Christians is still more tenuous. There is another religious group that has disappeared from Arab lands: Jewish communities.

**DORON LUBINSKY**  
Atlanta, Georgia

### The End of Plenty

By American standards our family is struggling financially. In the wake of the economic meltdown, my husband lost his job and now makes less than half of what he made before. With one child in kindergarten and a newborn, we've been under a lot of pressure. After

doing the math, we made the decision for me to stay home, sacrificing our health insurance. The kids have Medicaid. We do without many things we used to take for granted. If my husband hadn't received a lifetime subscription to your magazine as a child, we wouldn't receive it. We reluctantly accept government assistance to feed our family. This morning, I was mired in self-pity and grumbling about the state of our finances. Four out of five meals consist of beans and rice, and I was sick of it. I headed upstairs to nurse the baby. As I settled down with my son in my arms, I turned to the picture on page 36 depicting ■ starving baby in Ethiopia. My eyes filled with tears of shame. I couldn't help but compare that withered little boy

with the chubby infant on my lap. That boy is no less cherished than my child. I bet if his mother were plunked down in my life, she wouldn't know what to make of her good fortune. She wouldn't have time to complain. She'd be too busy cooking the beans and rice I disdain, planting vegetables in our yard, and feeding her child.

**MELISANDE TIMBLIN**  
Durham, North Carolina

We need to understand that factory farming of animals adds to the problem of starvation rather than diminishes it. The real solutions are increasing vegetarian eating, eliminating subsidies for agriculture, and encouraging population control.

**JOELLEN GILCHRIST**  
Beverly Hills, Michigan

How about we start reducing our dependence on fossil fuels and fertilizers for those overly green lawns? I'd love to see the expansive front lawns of giant houses planted with gardens.

**DIANA LAURENTIS**  
Canton, Massachusetts

### **Deep Southern Caves**

I've had recurring nightmares since childhood related to my only two great fears: drowning and getting stuck in an underground tunnel. Your photographs often trigger strong emotional reactions for me, but the image on pages 138-9 of John Benson wriggling under solid rock through standing water was the first to give me heart palpitations.

**KARL NELSON**  
Arlington, Virginia

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**GET ARE WE THERE YET? BACK**

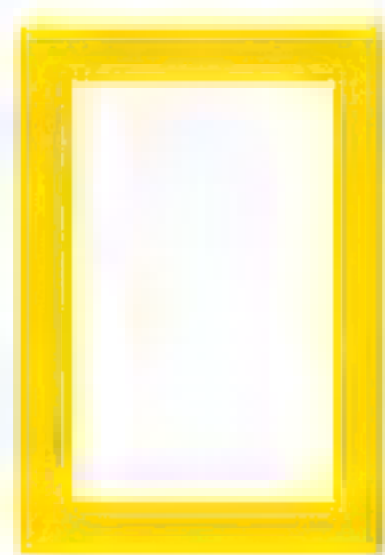
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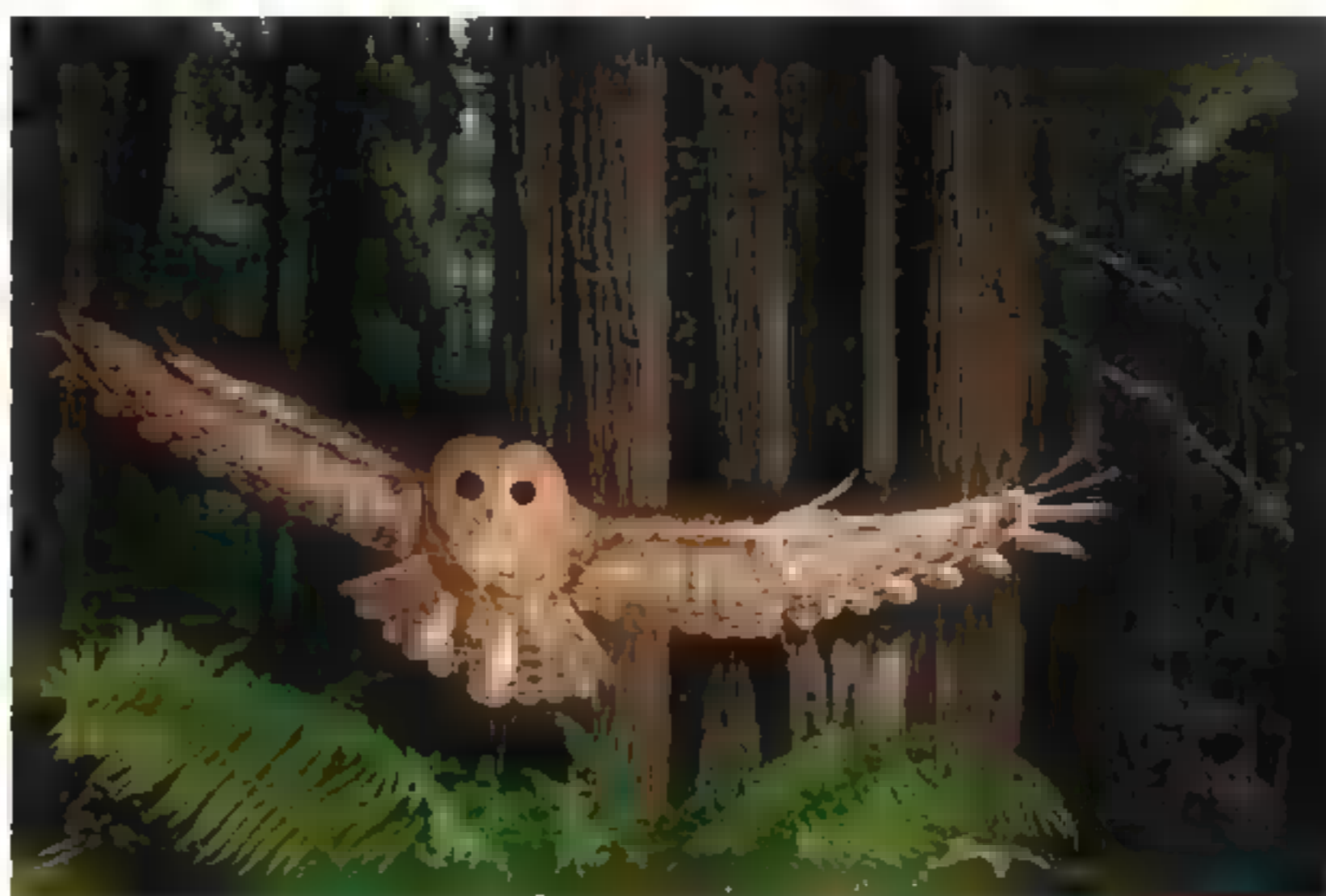
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## LETTERS

The experience of total darkness and tranquillity and claustrophobia in caves mentioned in your article—all of it is true! Forty-three years ago I was a 23-year-old salesman. A client named Wayne and I decided to take a long weekend trip with my boat to Missouri's Lake of the Ozarks. It was a hot, humid day on the lake when Wayne decided to show our group a cave that he had explored a year before. I was the last of the group to enter and will never forget the claustrophobic feeling of being on my stomach, slithering forward, and wondering how I was going to get out if I had to go backward. However, once I was inside, perhaps a hundred yards, it was cool and calm and quiet. We turned off

our lights, and it was exactly as the article said—total, stygian blackness. No way to see your hand one inch in front of you. Finally, quieted down, I did feel euphoria and total peace. I will never forget it. And I will never do it again. I am a surface guy.

**TOM FRASER**  
Dyer, Indiana

### Made in China

The "ornate bronze mirror" in the photograph at the lower right corner of page 115 is actually the *Ba Gua*, or the eight trigrams in Taoist cosmology. It is from the I Ching and represents the ebb and flow of energies in the universe and the law of the sacred or magic turtle. This system is used in feng shui and in aspects of Oriental medicine. It is ■

beautiful piece and deserves to be correctly identified.

**BARBARA BRANDON SCHWARTZ**  
Ocala, Florida

### River Spirits

My father, who was born in 1908 near Lake Maracaibo in Venezuela, told me about pink dolphins there. He used to play by the lake's beaches back in 1916, before oil was found. He had heard stories about the pink dolphins. They would help sinking swimmers by pushing them to shore. Once the lake started pumping out its entrails and the tankers invaded the once quiet waters, the pink dolphins disappeared. I am so glad that they still exist in the Amazon, at least for now.

**RITA IRIARTE-OSTAPOVITCH**  
East Hawkesbury, Ontario

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EDITORS' CHOICE

**John Neville** Nipomo, California

A 63-year-old railroad enthusiast, Neville was visiting Pingdingshan, China, when he saw ■ woman sifting through train ashes for coal to heat her home. "The irony," says Neville, "is that this is a coal-mining region—coal is everywhere."

**Nicholas McElroy** Grovetown, Georgia

In New York's Adirondack Mountains, National Guardsman McElroy, 25, spied a boater and thought, "If she paddles into the center of the pond, it would make an amazing picture."



READERS' CHOICE

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Vast and biodiverse, the Great Plains sustains owls in South Dakota (above) and yuccas in New Mexico (below).

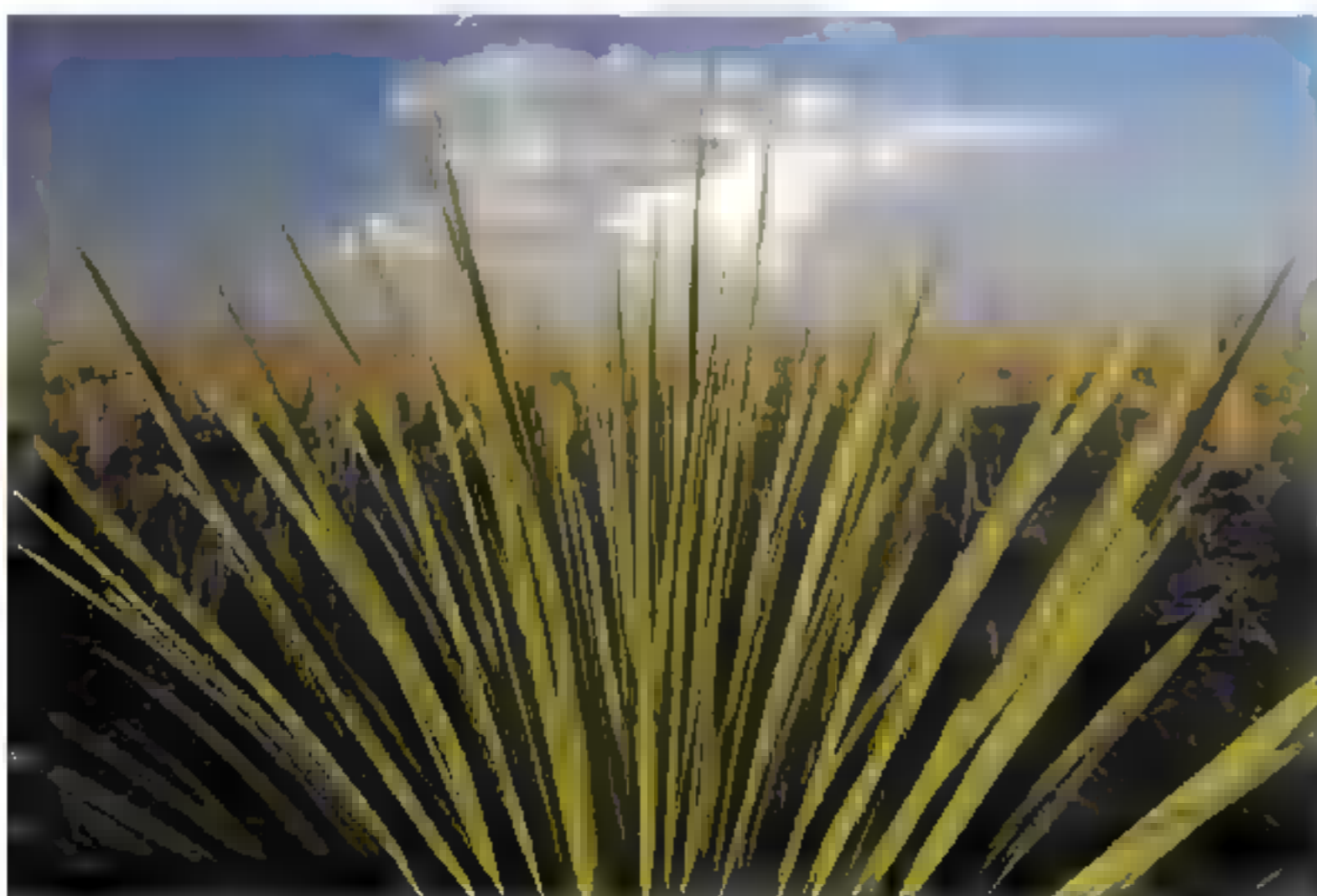
Michael Forsberg's book *Great Plains* is published by the University of Chicago Press. His website is [michaelforsberg.com](http://michaelforsberg.com).

**Home on the Prairie** Many people see the Great Plains as “fly-over country,” ■ million empty miles in the middle of America. It's a perception that's long hindered conservation efforts here. As a Nebraskan, I want to show them the amazing nexus of wildlife and diversity I know. Maybe then they'll see how much there is to save.

Less than 200 years ago, the area east of the Rockies and west of the Mississippi was one of the Earth's greatest grassland ecosystems, supporting 30 million bison, a billion prairie dogs, and herds of elk, pronghorn, and deer, along with top predators like wolves and grizzly bears. But modernization and indifference have altered

and endangered it. Animals have vanished. People have urbanized. The world's granary now doubles as an energy pump for oil, coal, biofuels, wind power, and natural gas.

Since 2005, I've logged 100,000 miles traveling the plains from Canada to Mexico, trying to put ■ face to the wild that still survives and make a case for why it matters. Renewing the region will depend on agriculturalists and environmentalists alike. Grass, soil, water, animals: These are common concerns. If we want this beautiful heartland to exist for our children and theirs, we have to see it clearly—and work together to conserve it.



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In Nebraska, restless waves of foxtail barley and alkali bulrush resemble a prairie ocean.



Hunted to near extinction before 1900, bison—including this herd in snowy South Dakota—now number 500,000.



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\*Estimated savings compares hybrid vehicle's EPA combined mpg rating with its segment's average based on latest EPA Trends Report (driven 15,000 miles annually). Actual mileage will vary. ©2009



Farm abandonment peaked in the 1930s and continues today. Here, hoarfrost haunts a former Nebraska farm.



A morning rainbow arcs over the Flint Hills of Kansas, home to butterfly milkweed and vestiges of unbroken prairie.



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**V**ISIONS OF EARTH



**United States** A kayaker plunges 70 feet into winter water at Washington State's Outlet Falls. His January 2009 descent was one of only five tallied on the Klickitat River tributary, here swollen by floods and sallow from runoff.

PHOTO: JED WEINGARTEN



**England** At London's Tooting Bec pool, four fancifully attired, color-coded women kick off the Cold Water Swimming Championships. More than 300 bathers, ages 12 to 85, competed and promoted the thrill of the chill.





**Switzerland** Neither a bird nor a plane, "Jet Man"—aka adventurer Yves Rossy—soars above the Alps on jet-propelled wings during a five-minute, 186-mile-an-hour flight. He has since flown over the English Channel.





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PHOTO: FABRICE COFFRINI, AFP/GETTY IMAGES



## Support the Future

"We believe in the work of National Geographic and wanted to be involved," says John Spinelli. He and his wife Shirley grew up reading *National Geographic* magazine and passed that love on to their children and grandchildren. Now retired, they enjoy in-line skating, tennis and bird watching.

The Spinellis set up a charitable gift annuity which provides them with steady income and tax savings while supporting the Society's efforts worldwide. "National Geographic is an important source for solutions to the challenges facing our planet," says John. "We want the world to be in good shape for our grandchildren."

For more information about a charitable gift annuity or other ways to include National Geographic in your estate plans, please contact the Office of Estate Planning.

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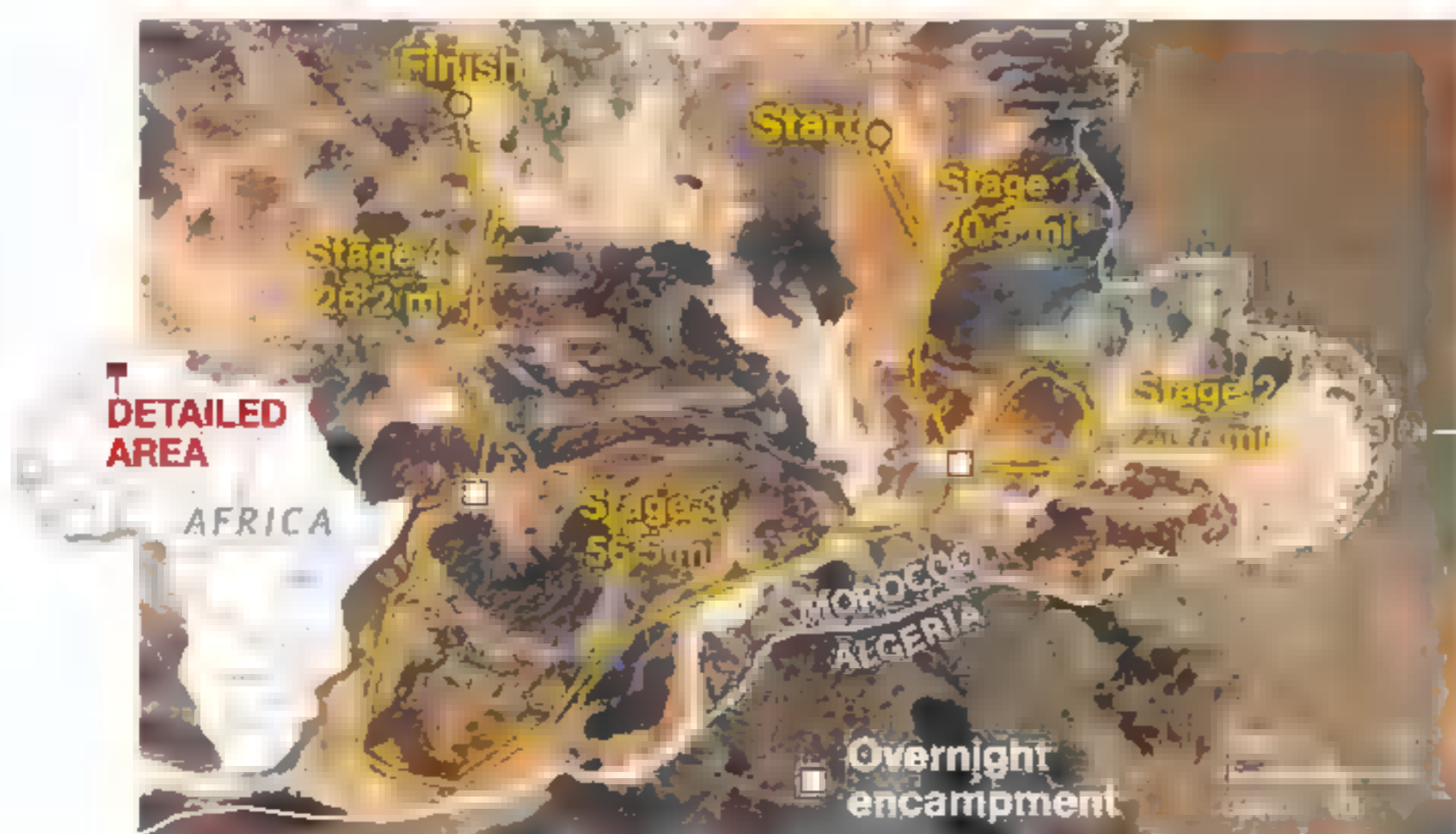


On ■ Moroccan ultramarathon, calves are clad in gaiters to keep sand out of socks and shoes.

**Run Like Crazy** Steve Holman, 52, is running 124.9 miles in the Sahara desert. All his food for the annual Marathon des Sables is in the 25-pound pack on his back (including potato chips he pulverized with a rolling pin to reduce bulk). In 100°F heat he struggles up a few 200-foot dunes, crawling on hands and knees at times. Alone in a sandstorm one night, not even sure he's headed in the right direction, he thinks, Yes! This is why I'm here!

His friends think he's nuts. That's a common view of "ultrarunning"—any race longer than ■ regular 26.2-mile marathon.

In the late 1800s ultrarunners would race round a track while spectators lay bets. Today loop races coexist with trail runs across the world. *UltraRunning Magazine* tallied 503 North American ultras last year with 30,789 finishes, a 20 percent jump over '07. Ultrarunners pay a price: nausea, pain, lost toenails. But they gain good friends and learn the human body is stronger than you'd imagine. Says Leslie Antonis, 47, who once ran 100 miles over 34 hours: "It's amazing what you can do without sleep." —Marc Silver



This spring the Marathon des Sables covered 124.9 miles over five days. Those who ran the 56.5-mile stage in 24 hours got ■ day off.



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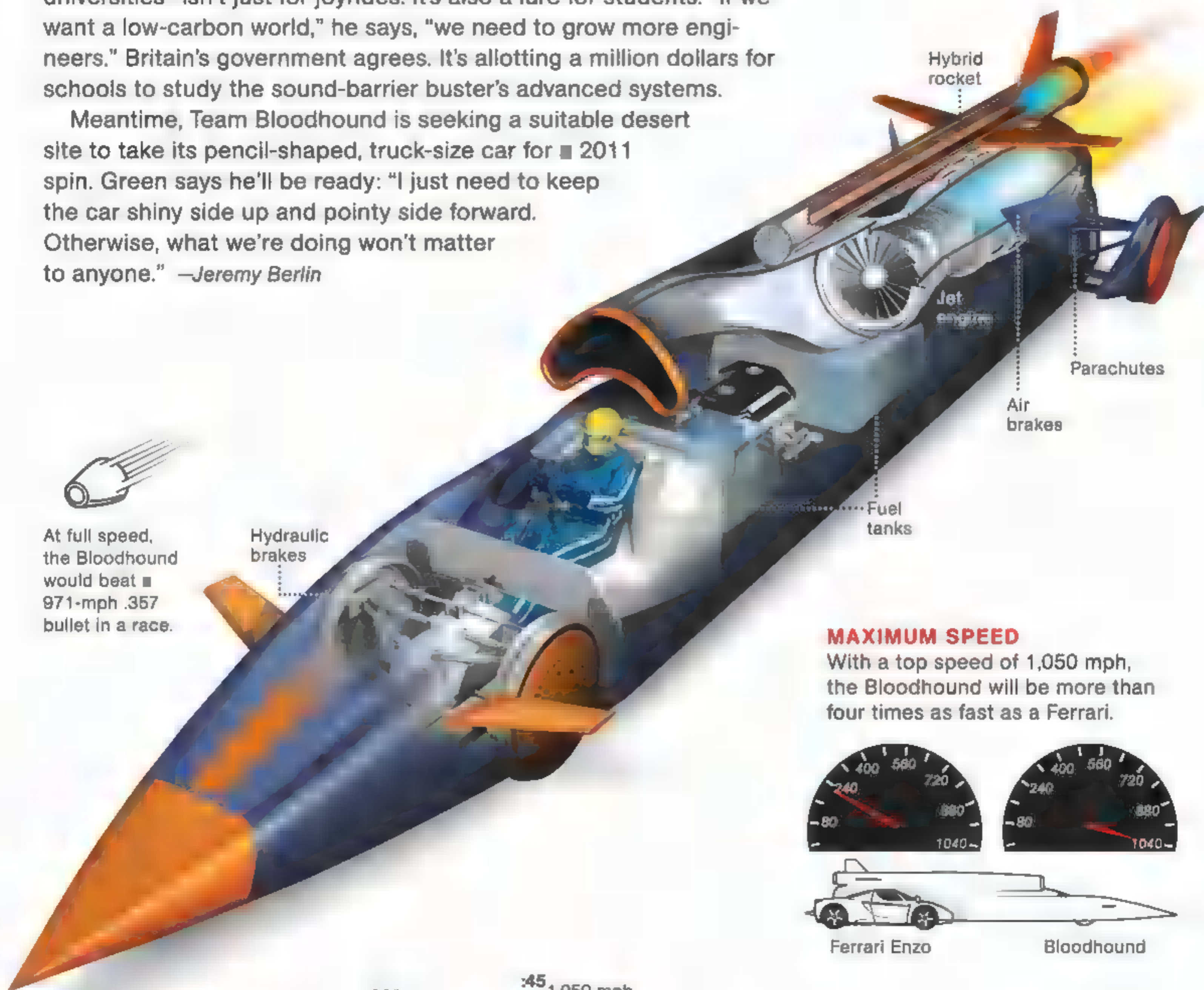
  
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# TECHNOLOGY

**Fastest Car** Quick, what's faster than a speeding bullet and *isn't* named Superman? The answer is the Bloodhound SuperSonic Car, or soon will be. Now being built in England, the jet-and-rocket-powered ride is designed to go, go, go 1,050 miles an hour. If it succeeds, it'll blast past the current land speed record of 763 miles an hour, set in 1997 by Andy Green in the jet-propelled Thrust SSC.

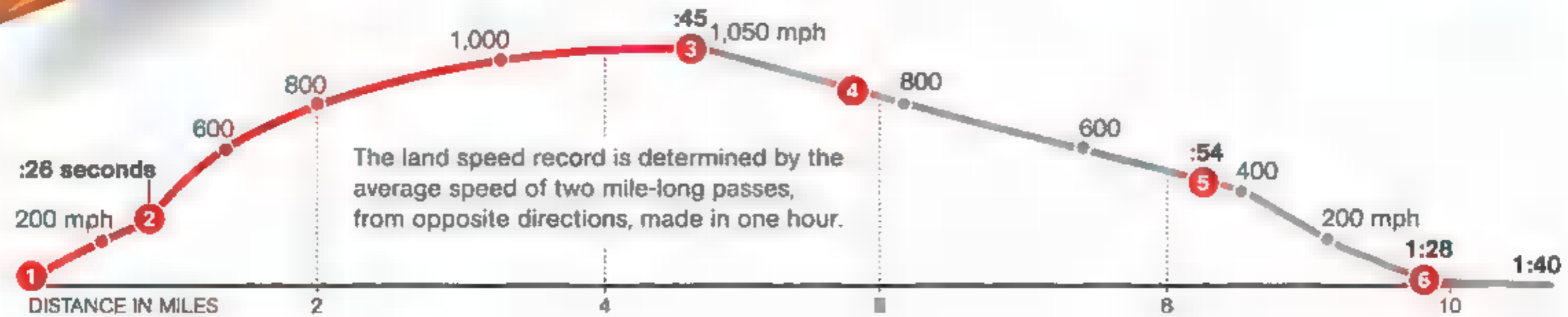
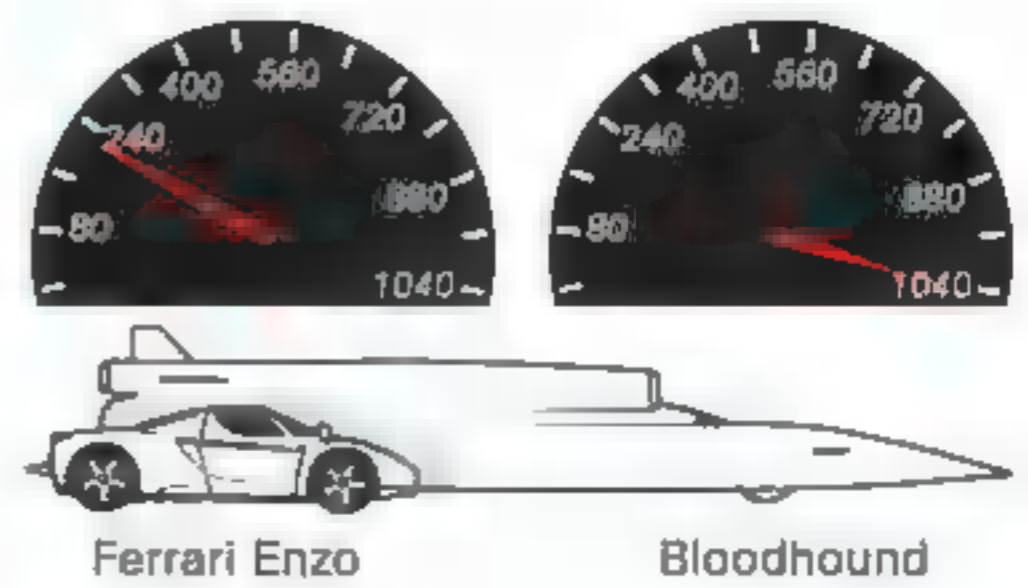
Green, a Royal Air Force pilot who'll also helm the Bloodhound, says the \$15-million vehicle—funded chiefly by corporations and universities—isn't just for joyrides. It's also a lure for students. "If we want a low-carbon world," he says, "we need to grow more engineers." Britain's government agrees. It's allotting a million dollars for schools to study the sound-barrier buster's advanced systems.

Meantime, Team Bloodhound is seeking a suitable desert site to take its pencil-shaped, truck-size car for a 2011 spin. Green says he'll be ready: "I just need to keep the car shiny side up and pointy side forward. Otherwise, what we're doing won't matter to anyone." —Jeremy Berlin



At full speed, the Bloodhound would beat a 971-mph .357 bullet in a race.

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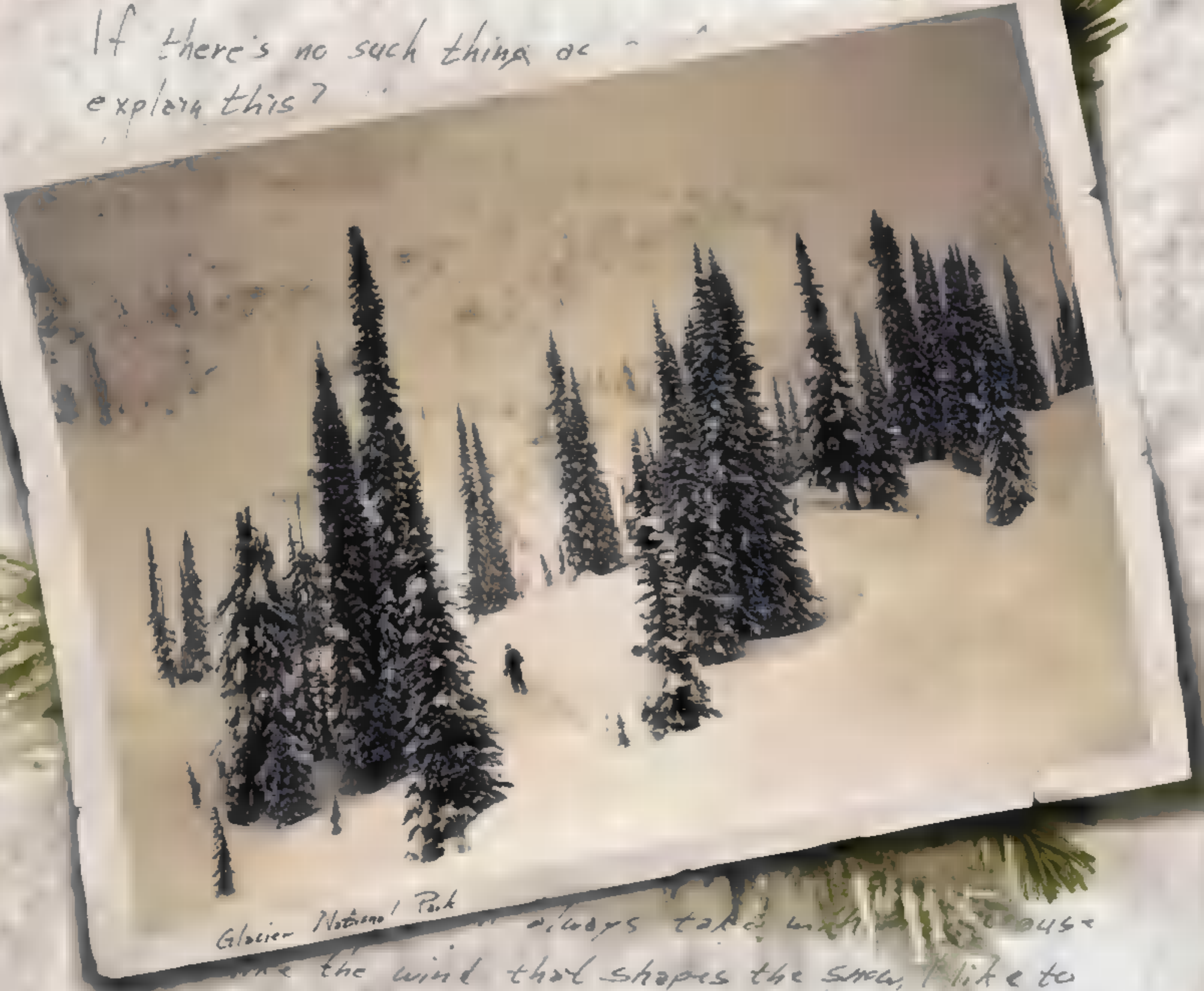
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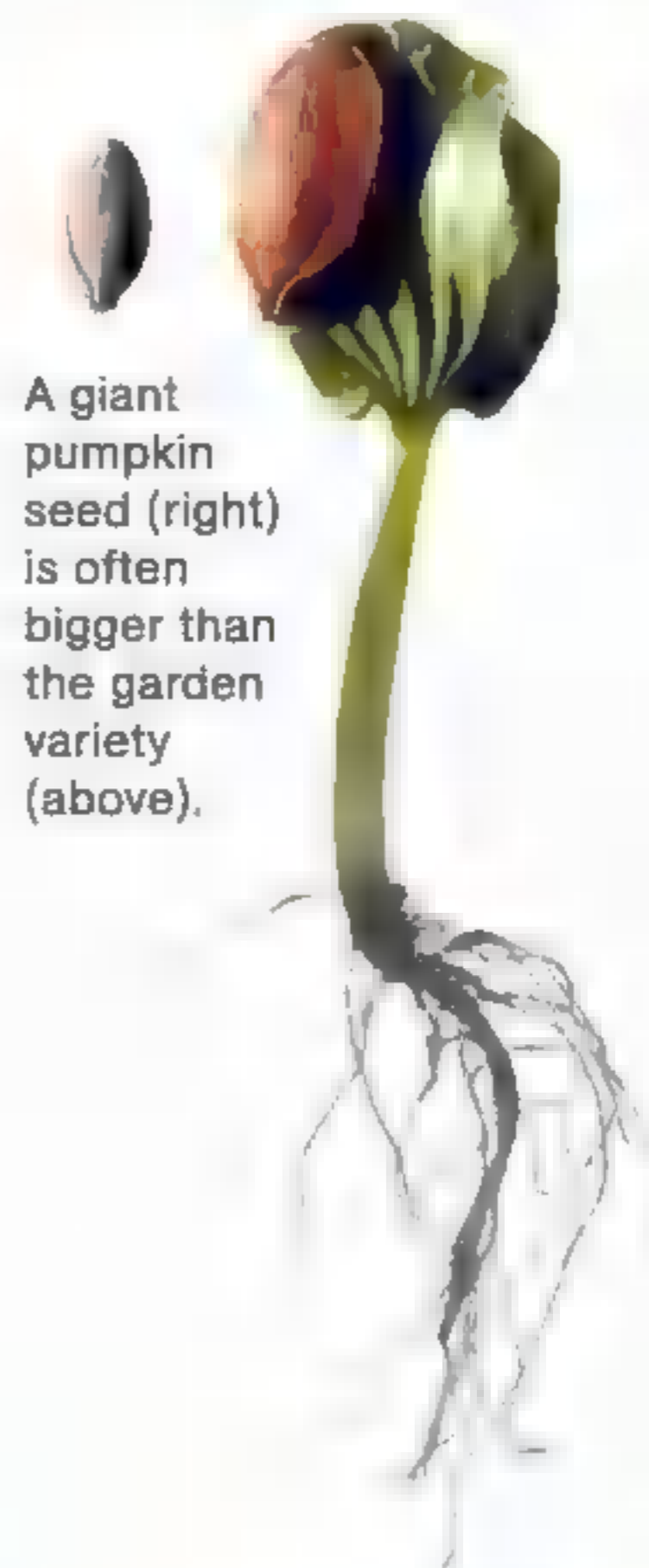


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**Pumped Up** In the world of giant pumpkins, a 500-pounder is ■ pip-squeak. “People don’t even blink at ’em,” says Danny Dill of Howard Dill Enterprises, which sells seeds whose DNA destines them for hugeness. The record is 1,689 pounds, set in 2007. “Within five years,” predicts Dill, “you’ll see a 2,000-pound pumpkin.”

Dill’s late dad was a giant-pumpkin pioneer. In the 1960s the fan of “biggest vegetable” contests fixated on pumpkins—much of their weight is water, so supersizing is relatively easy. Lots of nutrients and water work wonders on the right seed. Today farmers and obsessed amateurs worldwide pollinate a female flower from an apt male bloom and pick one pumpkin per vine to pamper. “My wife says I love the pumpkin more than I love her,” says Jamie Johnson of Arvada, Colorado, who tends his crop an hour each summer night.

After vying for prizes that can hit \$10,000, the gourds become jack-o’-lanterns, compost, even boats for a wacky regatta. Sadly, huge pumpkins aren’t as flavorful as the typical 20-pound specimen. Not that growers mind: They’re in it for the zen of gardening and the thrill of a colossal squash. “I don’t even like pumpkin pie,” says Jim Gerhardt of Berks County, Pennsylvania. —Marc Silver



A giant pumpkin seed (right) is often bigger than the garden variety (above).



A tiny crack in the bottom of New Englander Steve Connolly’s 1,568-pound pumpkin cost it a prize last year.



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# HEALTH

**Human Limits** A 64-year-old Duluth woman fell on the ice last December. Arthritis kept her from getting up. She lay in the snow for hours. Her temperature dipped to 70°F. Her heart stopped. She should have been a goner. But doctors revived her; today she is fine. Medical science is always learning more about how much a body can take. Yet as Duke University physician Claude Piantadosi notes, "At some point it's impossible to rescue yourself." Here's current thinking on the extremes of human endurance. —Shelley Sperry

107.6°F



### Body Heat

When core body temperature hits 107.6°F, heatstroke can't be reversed and will prove fatal.

40°F



### Cold Water

Water saps body heat. You'd last barely 30 minutes in a 40°F sea. Life vests buoy you up to slow heat loss.

300°F



### Hot Air

In a burning building or deep mine, adults can take 10 minutes at 300°F. Kids soon succumb in a 120° car.

15,000 feet



### High Altitude

Consciousness fades for most. With bigger lungs and more red blood cells, highland dwellers are OK.

282 feet



### Diving Deep

Without equipment, most folks black out before 2 minutes and below 60 feet. The best free diver made it to 282 feet.

11 minutes



### Lack of Oxygen

Typically, you'd pass out within 2 minutes. With training, people can hold their breath nearly 11 minutes.

40%



### Blood Loss

You can survive after spilling 30 percent. At 40 percent, you'd need an immediate transfusion.

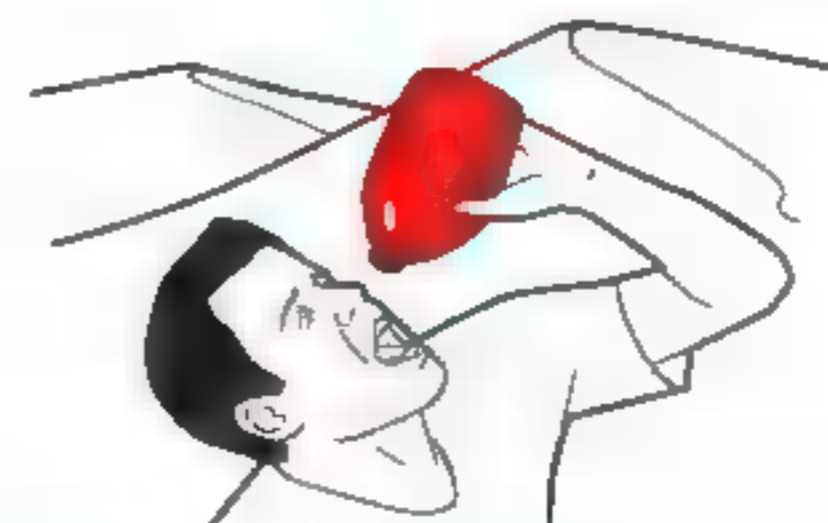
45 days



### Starvation

Lose 30 percent of body weight and death is imminent, though disease will likely kill you before you starve.

7 days



### Dehydration

Every cell needs water. Replace the quart or so you lose daily, or you won't last much more than a week.

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The star-nosed mole's 22 sensory tentacles—less than an inch across—get an electron micrograph close-up.

The "star," with some 100,000 nerve endings, gives *Condylura cristata* its sensitive touch. Claws give it scraping power.

**Fleet Eater** What outlandish snoot is this? A handy one that helps the star-nosed mole clock in as the fastest forager among mammals. As the mole claws at wetland soil or stream sediment, the tentacles about its nose probe up to 13 spots ■ second for invertebrates, insect larvae, and other prey. Then in 230 milliseconds—quicker than our eyes can flit to a flash of light—the mole scrutinizes and devours the edibles. That's a record for pinpointing and eating food. (Bats are the likely runners-up.)

Five times more sensitive than human fingertips, the tentacles let this virtually blind animal perceive minute prey its competitors miss. "It's one of the most acute skin-sensory systems of any creature," says Vanderbilt University biologist Kenneth Catania, who studies the species. Equally effective underwater, those fleshy appendages feel for bottom dwellers as the mole inhales its exhaled bubbles to sniff out the meal—the latter a skill Catania recently discovered. "This mole," he says, "just keeps surprising us." —Jennifer S. Holland





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# TECHNOLOGY

**A Grander K** What is a kilogram? It's 2.2 pounds, of course. Or is it? The kilo is the only basic international standard pegged to ■ physical object—a 120-year-old platinum-iridium cylinder kept in ■ vault outside Paris and known as Le Grand K. In recent years scientists noticed slight variations in the cylinder's weight. They've gone into high gear to redefine the kilo as a universal constant based on nature instead of an object vulnerable to distortion.

Physicists in some countries are analyzing near-perfect spheres of pure silicon crystal that will allow them to count the number of atoms in a kilo for the first time. Other scientists are measuring the kilo in terms of gravity and magnetism. Once results are confirmed, an international committee will make the final decision on redefinition, perhaps as soon as 2011. "It'll be a grand thing," says physicist Richard Steiner, who leads the American effort. Then Le Grand K can gain or lose as much weight as it wants. —Hannah Bloch

## STANDARD SOLUTIONS

Unlike the kilogram, the other six basic international units—meter, second, ampere, kelvin, mole, and candela—are defined by universal measures. The meter is defined by the length light travels in 3.3 nanoseconds.

A close-up photograph showing a hand wearing a blue nitrile glove holding a small, clear, spherical silicon crystal. The sphere is being held over a metallic scale. The sphere's surface is highly reflective, showing a distorted view of the laboratory environment, including a person in a white lab coat and various pieces of equipment. The lighting is bright, highlighting the texture of the glove and the metallic surfaces of the scale.

German physicist Arnold Nicolaus wants to count the atoms in this silicon sphere to set a standard for the kilogram.

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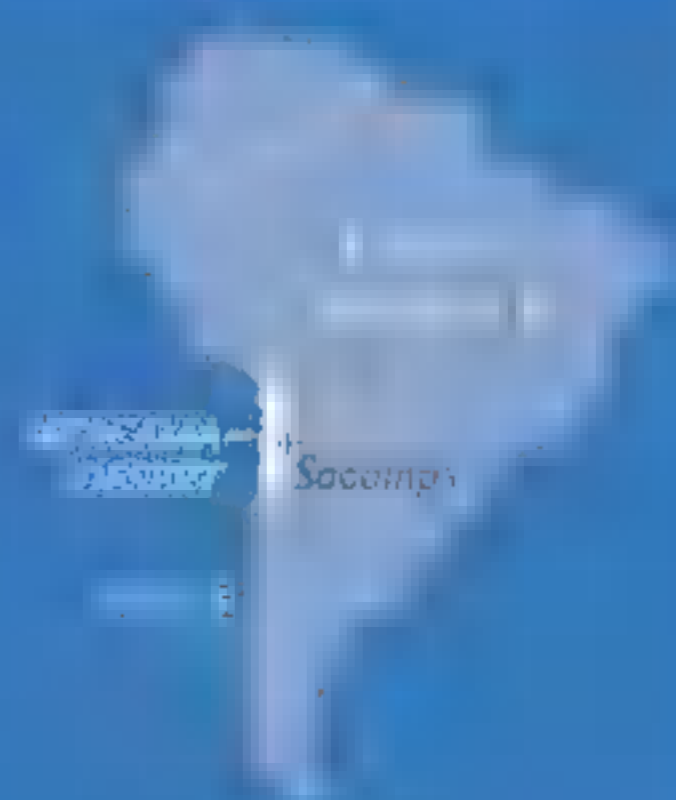
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\*This promotion is valid for foreign visitors traveling to Panama between August 1st and October 31st, 2009. Discounts are valid only for businesses listed on visitpanama.com and to be effective require the presentation of the affiliation card. Restrictions indicated by the participating establishments apply and vary according to each offer. For further information on the terms and conditions please access the webpage or call the participating companies. Neither the Panamanian Tourism Authority nor the promotion company, P4 Ogilvy, will be responsible for compliance with the transactions between the participating businesses and the consumer.

**Life on the Edge**

When it comes to hostile environments, few places can match Chile's Atacama Desert. It's one of the meanest places on the planet, receiving by just half an inch of rain a year. So no one thought the region's 28,000-foot-tall Salar de Atacama could sustain much life. In fact, its barren, dried-out environment and intense ultraviolet radiation suggest conditions on Mars.

Recently, though, microbial ecologist Steven Schmedt, a National Geographic grantee, and his team discovered the world's highest-altitude bacteria near the volcano's summit. It's not clear how the microbes grow in such inhospitable terrain. But for scientists seeking life signs on Mars, they're a cause for hope: "Just as Earth's bacteria may hold biotechnological promises, various promising building blocks for sunscreen compounds, after all, Schmedt says, may "have an amazing ability to resist the sun." —*EWAN MCKAY*



The desiccated remains of livestock litter the Atacama Desert, inhospitable to most life-forms.



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*Crassostrea ariakensis*

### ACTUAL SIZE

The Suminoe oyster (above) grows faster than the Chesapeake Bay native (below).

**Shell Shock** Jamestown colonist George Percy wrote in 1607 that the oysters of the Chesapeake Bay lay "as thicke as stones." In the 1970s the bay's watermen hauled in about 25 million pounds of them a year. Now overharvesting, pollution, and disease have taken their toll, and the oysters are almost gone. The bay's water is in terrible condition, in part because there are too few bivalves to filter it.

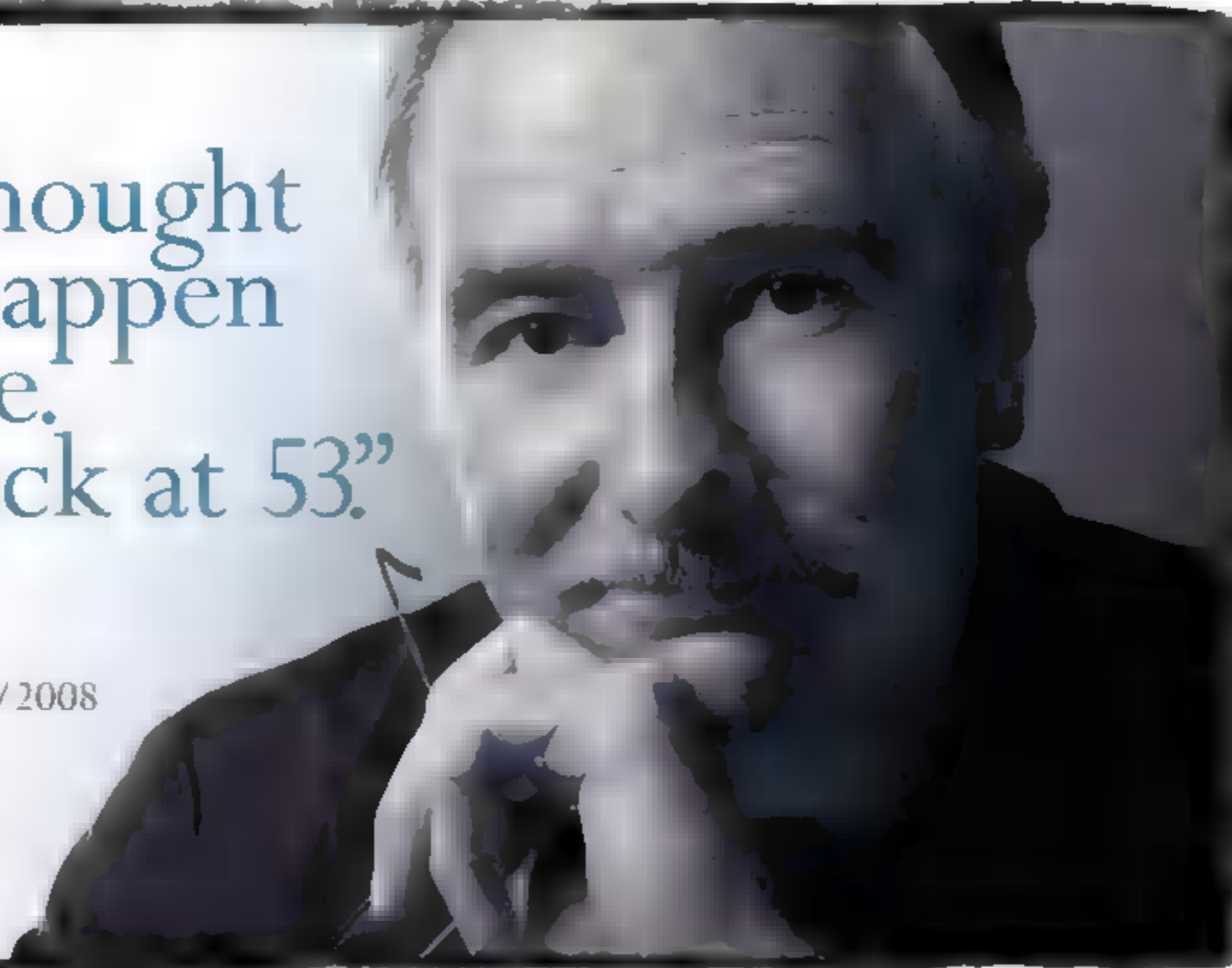
Introducing the hardy and fast-growing Asian Suminoe oyster was a possible solution. After much study, the U.S. Army Corps of Engineers and the states of Maryland and Virginia rejected the proposal this year, fearing the species could turn invasive and further disrupt the already imperiled ecosystem. The goal now is to protect the small population of native oysters and build them back over time. —Catherine L. Barker



*Crassostrea virginica*

“I never thought  
it could happen  
to me.  
A heart attack at 53.”

~Steve A.  
New York, NY  
Heart attack: 1/9/2008



“I had been feeling fine. But turns out my cholesterol and other risk factors\* increased my chance of a heart attack. Now I trust my heart to Lipitor. Talk to your doctor about your risk and about Lipitor.”

- Adding Lipitor may help, when diet and exercise are not enough. Unlike some other cholesterol-lowering medications, Lipitor is FDA-approved to reduce the risk of heart attack and stroke in patients with several common risk factors, including family history, high blood pressure, low good cholesterol, age and smoking.
- Lipitor has been extensively studied with over 16 years of research. And Lipitor is backed by 400 ongoing or completed clinical studies.

\*Patient's risk factors include age, gender, smoking, and high blood pressure.

**IMPORTANT INFORMATION:** LIPITOR is a prescription drug. It is used in patients with multiple risk factors for heart disease such as family history, high blood pressure, age, low HDL (‘good’ cholesterol) or smoking to reduce the risk of heart attack, stroke and certain kinds of heart surgeries. When diet and exercise alone are not enough, LIPITOR is used along with a low-fat diet and exercise to lower cholesterol.

LIPITOR is not for everyone. It is not for those with liver problems. And it is not for women who are nursing, pregnant or may become pregnant. If you take LIPITOR, tell your doctor if you feel any new muscle pain or weakness. This could be a sign of rare but serious muscle side effects. Tell your doctor about all medications you take. This may help avoid serious drug interactions.

Your doctor should do blood tests to check your liver function before and during treatment and may adjust your dose. The most common side effects are gas, constipation, stomach pain and heartburn. They tend to be mild and often go away.

LIPITOR is one of many cholesterol-lowering treatment options that you and your doctor can consider.

*Please see additional important information on next page.*



 Have a heart to heart with your doctor about your risk. And about Lipitor.  
Call 1-888-LIPITOR (1-888-547-4867) or visit [www.lipitor.com/steve](http://www.lipitor.com/steve)

*You are encouraged to report negative side effects of prescription drugs to the FDA.  
Visit [www.fda.gov/medwatch](http://www.fda.gov/medwatch) or call 1-800-FDA-1088.*

# IMPORTANT FACTS



**LIPITOR**  
atorvastatin calcium  
tablets

(LIP-ih-tore)

## LOWERING YOUR HIGH CHOLESTEROL

High cholesterol is more than just a number, it's a risk factor that should not be ignored. If your doctor said you have high cholesterol, you may be at an increased risk for heart attack. But the good news is, you can take steps to lower your cholesterol.

With the help of your doctor and a cholesterol-lowering medicine like LIPITOR, along with diet and exercise, you could be on your way to lowering your cholesterol.

Ready to start eating right and exercising more? Talk to your doctor and visit the American Heart Association at [www.americanheart.org](http://www.americanheart.org).

## WHO IS LIPITOR FOR?

### Who can take LIPITOR:

- People who cannot lower their cholesterol enough with diet and exercise
- Adults and children over 10

### Who should NOT take LIPITOR:

- Women who are pregnant, may be pregnant, or may become pregnant. LIPITOR may harm your unborn baby. If you become pregnant, stop LIPITOR and call your doctor right away.
- Women who are breast-feeding. LIPITOR can pass into your breast milk and may harm your baby.
- People with liver problems
- People allergic to anything in LIPITOR

## BEFORE YOU START LIPITOR

### Tell your doctor:

- About all medications you take, including prescriptions, over-the-counter medications, vitamins, and herbal supplements
- If you have muscle aches or weakness
- If you drink more than 2 alcoholic drinks a day
- If you have diabetes or kidney problems
- If you have a thyroid problem

## ABOUT LIPITOR

LIPITOR is a prescription medicine. Along with diet and exercise, it lowers "bad" cholesterol in your blood. It can also raise "good" cholesterol (HDL-C).

LIPITOR can lower the risk of heart attack or stroke in patients who have risk factors for heart disease such as:

- age, smoking, high blood pressure, low HDL-C, heart disease in the family, *or*
- diabetes with risk factor such as eye problems, kidney problems, smoking, or high blood pressure

## POSSIBLE SIDE EFFECTS OF LIPITOR

### Serious side effects in a small number of people:

- **Muscle problems** that can lead to kidney problems, including kidney failure. Your chance for muscle problems is higher if you take certain other medicines with LIPITOR.
- **Liver problems.** Your doctor may do blood tests to check your liver before you start LIPITOR and while you are taking it.

Symptoms of muscle or liver problems include:

- Unexplained muscle weakness or pain, especially if you have a fever or feel very tired
- Nausea, vomiting, or stomach pain
- Brown or dark-colored urine
- Feeling more tired than usual
- Your skin and the whites of your eyes turn yellow

If you have these symptoms, call your doctor right away.

### The most common side effects of LIPITOR are:

- Headache
- Constipation
- Diarrhea, gas
- Upset stomach and stomach pain
- Rash
- Muscle and joint pain

Side effects are usually mild and may go away by themselves. Fewer than 3 people out of 100 stopped taking LIPITOR because of side effects.

## HOW TO TAKE LIPITOR

### Do:

- Take LIPITOR as prescribed by your doctor.
- Try to eat heart-healthy foods while you take LIPITOR.
- Take LIPITOR at any time of day, with or without food.
- If you miss a dose, take it as soon as you remember. But if it has been more than 12 hours since your missed dose, wait. Take the next dose at your regular time.

### Don't:

- Do not change or stop your dose before talking to your doctor.
- Do not start new medicines before talking to your doctor.
- Do not give your LIPITOR to other people. It may harm them even if your problems are the same.
- Do not break the tablet.

## NEED MORE INFORMATION?

- Ask your doctor or health care provider.
- Talk to your pharmacist.
- Go to [www.lipitor.com](http://www.lipitor.com) or call 1-888-LIPITOR.

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News Flash....

## Government Gets Something Right



### Super Light Titanium Timepiece Loses Only One Second Every 20 Million Years.

**BOULDER, Colorado** The U.S. government has engineered the most ingenious, most accurate clock in the world: the F-1 U.S. Atomic Clock in Boulder, Colorado. Our extraordinary new Stauer Titanium Atomic Watch utilizes the transmissions directly from that remarkable cesium fission atomic clock to report the most precise time. This scientifically advanced timepiece will gain or lose only one second over a 20 million-year period. It is that accurate! This perfectly tuned technological invention with the super light strength of titanium is now available for UNDER \$200.

**Super Light Titanium has two big advantages over steel.** One is corrosion resistance and the other is that titanium has the highest strength-to-weight ratio of any metal, which means that titanium is approximately 45% lighter than steel. But every other titanium watch that we can

find is priced at over \$400, and none of those are nearly as accurate as our atomic movement. Stauer has decided to bring these resources together in a timepiece that has the most accurate movement available today. You'll never have to set this watch. Just push one of the buttons and you are synchronized with the atomic clock in Colorado, and the hands of the watch move to the exact time position. The sleek black textured dial has luminous hands and markers plus the timepiece is water resistant to 3 ATM.

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The Stauer Titanium Atomic Watch is not available in stores and it comes with our 30 day money-back guarantee. If you're not completely satisfied with the accuracy, simply return the watch for the full purchase price.

*Not Available in Stores*

**Stauer Titanium Atomic Watch ~~\$195~~ now \$145 +S&P or 2 credit card payments of \$72.50 + S&P**

Call Toll-Free now to take advantage of this limited offer.

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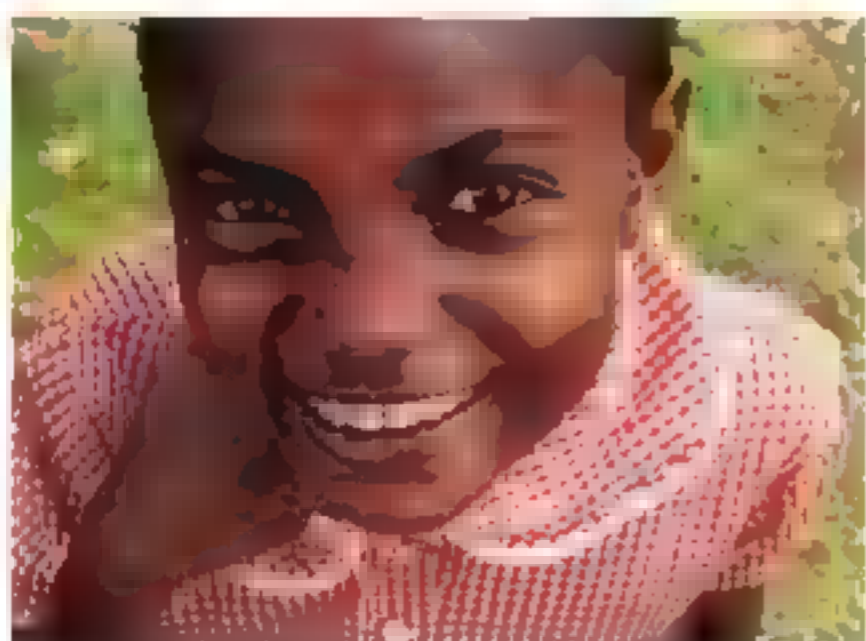
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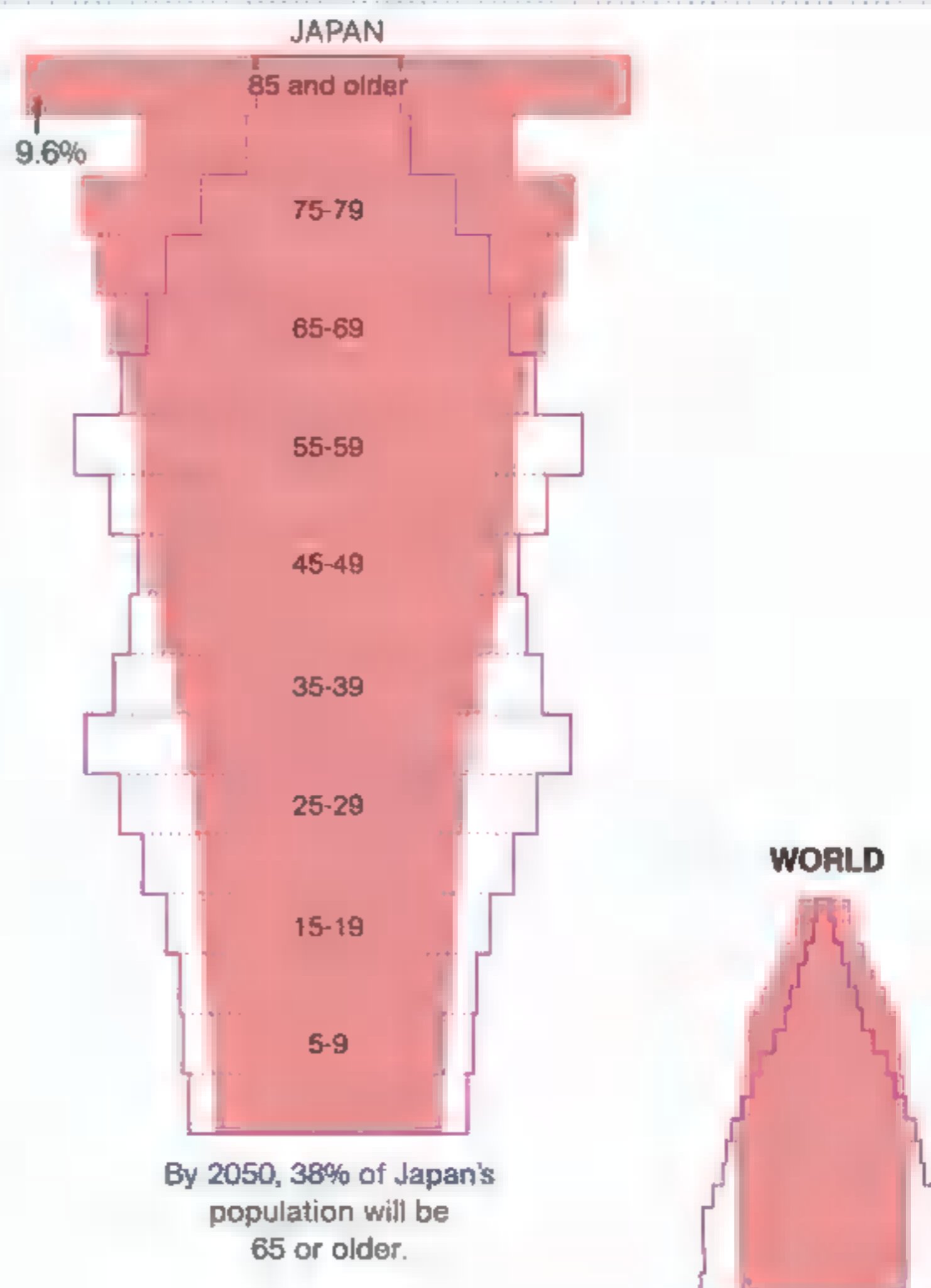
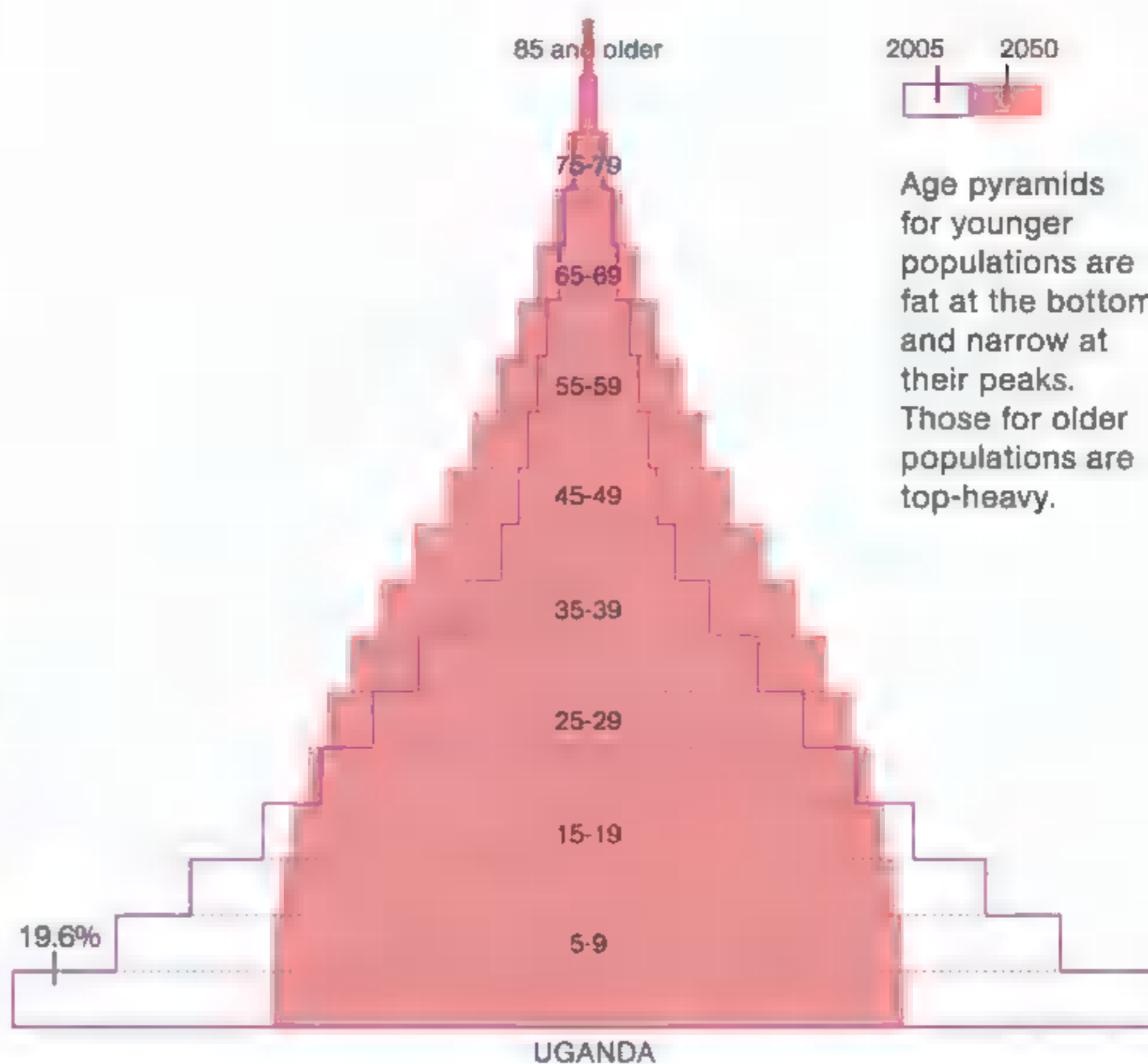
## Modern Ages

To the familiar divides—rich and poor, north and south, modern and traditional—add a new one: young and old. That's because the average ages of the world's populations are diverging, as some nations skew up or down. Youth booms persist in poor places like Uganda, where almost half the people (like this Kampala orphan, below) are under 15. Meantime, much of the industrialized world is aging.



In Japan 20 percent of the people are 65 or over (like 102-year-old Kamada Nakazato, above). Other nations with a large share of elderly include Germany, Italy, and much of eastern Europe. Demographers have predicted all countries will grow older as women give birth to fewer children. But in Africa and isolated states like Yemen, where women don't always seek or have access to birth control, long-running baby booms continue—and the gap widens. —Karen E. Lange

By 2050, 69% of Uganda's population will be younger than 35.



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### LEGAL NOTICE

#### IN THE CIRCUIT COURT FOR THE THIRD JUDICIAL CIRCUIT MADISON COUNTY, ILLINOIS **CLASS ACTION SETTLEMENT SUMMARY NOTICE**

**TO:** All Persons who, from October 26, 1989 through July 16, 2009, were injured in an automobile accident while drivers or passengers in an automobile insured by Allstate Insurance Company or a related entity ("ALLSTATE"), or submitted a claim to ALLSTATE under a homeowner's policy, and (a) who submitted claims under personal injury protection (PIP) or medical payments (MedPay) coverage for medical bills to ALLSTATE; (b) had those MedPay or PIP claims adjusted with the use of an ADP/MBRS computer recommendation; (c) received an amount less than the amount of the submitted medical expenses; and (d) received or were tendered an amount less than the full amount of the stated policy limits; as well as all medical providers and entities who, by written assignment, have the right to assert such claims. The Settlement Class shall exclude directors and officers of ALLSTATE and all members of the settlement class in Coffell v. Allstate, No. 05-2-33183-6 (Super. Ct. Wash. For King County).

Class action litigation against ALLSTATE has been pending in the Circuit Court of Madison County, Illinois. The Court preliminarily certified, for settlement purposes only, the Settlement Class above, and authorized publishing this Notice.

**PLEASE TAKE NOTICE** that the Court (Judge Ruth) will hold a hearing on November 25, 2009 at 10:30 a.m., at the Courthouse for the Circuit Court of Madison County, Illinois, Room 311, Edwardsville, Illinois 62025, to determine: whether the Court should finally approve the Proposed Settlement, bind the Class Members to the release set forth in the Proposed Settlement and enjoin Class Members from participating in or receiving benefits from any other lawsuit or other proceeding in any jurisdiction based on or relating to the Released Claims (as defined in the Settlement Notice and Stipulation of Settlement) in this case.

**Class Description.** The Court certified, for settlement purposes only, the class above. The Proposed Settlement covers ALLSTATE, and any of its parents, affiliates, stockholders, subsidiaries or divisions, or any other successors, assigns or legal representatives thereof.

A detailed Settlement Notice will be mailed to potential class members upon request. Potential class members should request a copy of that Notice by calling: 888-236-0299, or by accessing the following website: [www.strasensettle.com](http://www.strasensettle.com). The Proposed Settlement and the scheduled Court hearing may affect the Class Members' rights.

The Court appointed the following counsel as Lead Counsel for the Class:

Bradley M. Lakin  
LAKIN CHAPMAN LLC  
300 Evans Ave.  
Wood River, IL 62095  
Phone: (618) 254-1127

Email: [Medpay.classaction@LakinChapman.com](mailto:Medpay.classaction@LakinChapman.com)

**DO NOT TELEPHONE THE COURT OR THE CLERK OF THE COURT.**

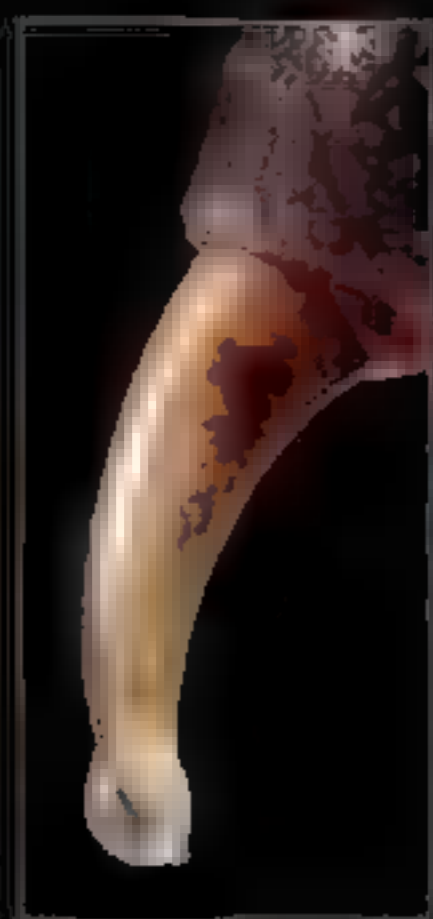
Dated: July 16, 2009, Edwardsville, Illinois.

/s/ Honorable Judge Ruth



**Reptilian Roots** The platypus is so bizarre its discovery was first dismissed as a hoax. After an Australian specimen arrived in London in 1798, biologists had to make a call: reptile or mammal? On the mammal side, it was covered in thick fur and nursed its young—with milky patches on the belly instead of nipples. On the reptile side, it laid eggs. Scientists voted mammal. Now researchers have sequenced the platypus genome, confirming the classification but also finding much reptile-like DNA.

Mammals and reptiles share common ancestry but headed down separate evolutionary paths 315 million years ago. The platypus is a rare window on those first mammals, which had reptile traits such as egg laying. When the platypus branched off from the ancestors of most living mammals, it kept both its mammalian and reptilian DNA. Like rats, the platypus has genes linked to a keen sense of smell, which may help it find food. Like snakes, the platypus developed venom—with genes inherited from their common ancestor. Male platypuses inject the venom through spurs (left) on their hind legs when they fight over mates. —Karen E. Lange



A freshwater oddity found only in Australia, the platypus resembles early reptile-like mammals.





I've gone GREEN

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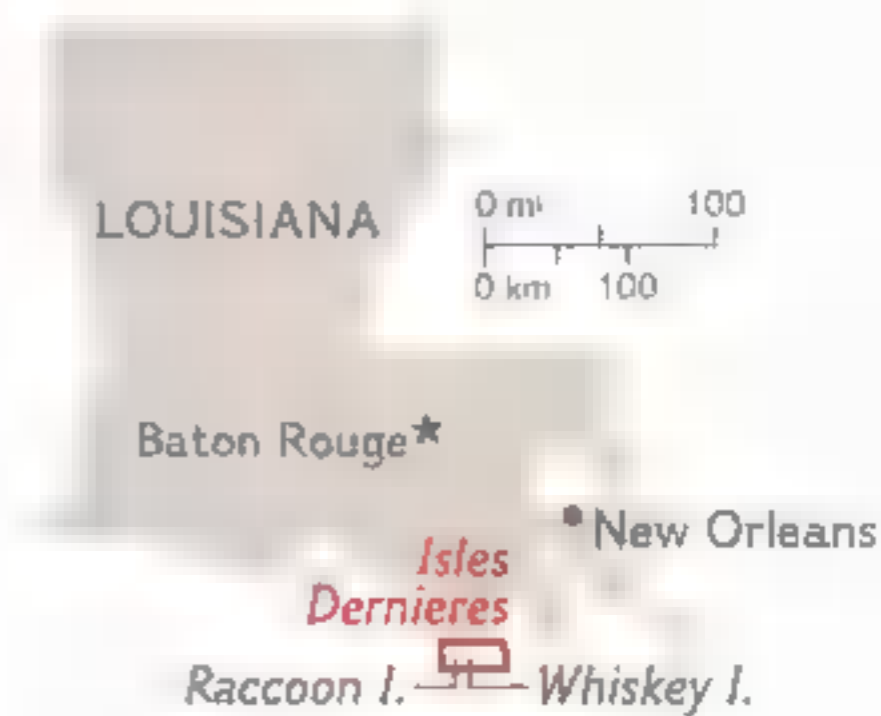
**Dominican Republic**  
Has it all



# CONSERVATION

**Pelican Special Delivery** When Louisiana lawmakers named the brown pelican the state bird, they missed an important point: There were no brown pelicans left there. That was in 1966, after years of pesticide runoff had ruined eggs and silenced once teeming coastal rookeries. Not long after the legislative gaffe, biologists set about reviving the state's nesting colonies, relocating young birds from Florida. It was a huge success: 350,000 pelicans were born in Louisiana after 1971. Then came the hurricanes.

Katrina and Rita in 2005 and Gustav and Ike in 2008 punished pelican-rich barrier islands along the Gulf Coast, badly damaging rookeries east of the Mississippi River mouth. The largest colony, with 5,500 nests, now lies to the west, on Raccoon Island, "a skinny little place barely above water," says University of Louisiana at Lafayette biologist Scott Walter. Given the recent frequency of Gulf storms, scientists are hurrying to once more establish new brown pelican rookeries. For each of the past two summers, Walter has rounded up a hundred snappish chicks on Raccoon and ferried them six miles east to Whiskey Island. He hopes the birds will imprint there and, in three years, instinctively return to build nests in the mangroves. The state bird deserves no less. —Tom O'Neill



The Isles Dernieres Barrier Islands Refuge shelters half of Louisiana's 12,000 or so brown pelican nesting pairs.



A nine-week-old brown pelican awaits its transfer from Raccoon Island to nearby Whiskey Island.

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# Fold Everything



Anything can be made with origami—from birds and bugs to stents and space telescopes. It's just a matter of math.

**One sheet, no cuts:** Even in its simplest form, origami, the art of paper folding, generates enchantment. Since the earliest known manual, *A Thousand Cranes*, was published in Japan in 1797, flocks of paper birds have alighted on countless windowsills. But these days, the ancient art is being revitalized by another form of expression: math. By describing their work mathematically and modeling it with computers, origamists have jumped from paper to metal and plastic and from toy to technology. Folded creations have flown in space; someday one may lodge in your artery.

"It's now mathematically proven that you can pretty much fold anything," says physicist Robert J. Lang, who quit his job in Silicon Valley eight years ago to fold things full-time, including centipedes with a full set of limbs and snakes with a thousand scales. "We've basically solved how to create any appendage or shape."

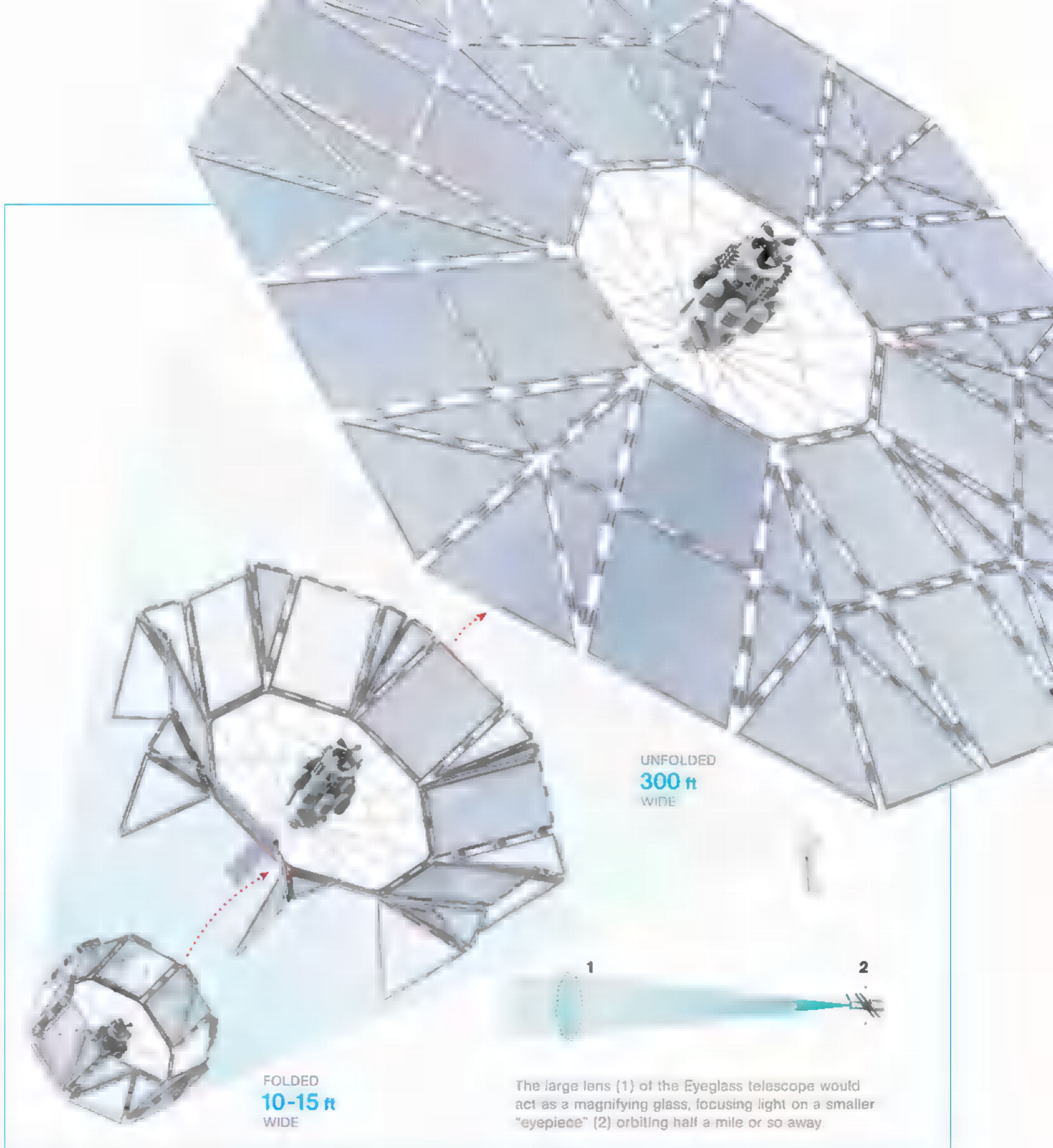
Each appendage consists of a folded flap of paper, and each flap, origamists realized in the 1990s, uses a circular portion, or a quarter or half circle, of the original square. It was a crucial insight, Lang says, because it allowed them to connect their basic problem—how to plan creases that will give a sheet of paper a desired shape—to



## 1

### PAPER PLANE

Japanese scientists hope to launch origami planes made of sugarcane-fiber paper from the International Space Station. If the planes' slow fall and protective coating keep them from burning up in the atmosphere, they might inspire new spacecraft designs.



UNFOLDED  
300 ft  
WIDE

FOLDED  
10-15 ft  
WIDE

The large lens (1) of the Eyeglass telescope would act as a magnifying glass, focusing light on a smaller "eyepiece" (2) orbiting half a mile or so away.

## 2

### TELESCOPE LENS

Careful creasing would allow a plastic space telescope lens the size of a football field to fold small enough to fit into a payload bay. Scientists at Lawrence Livermore National Laboratory built a prototype of the Eyeglass telescope in 2002.



FOLDED  
0.5 in  
WIDE

UNFOLDED  
1-2 in  
WIDE

## 3

### ARTERY LINING

A new stent graft developed by University of Oxford scientists folds along helical creases for insertion by catheter into the abdominal aorta, then expands in place to support the damaged artery. Human trials of the device could begin by 2012.

---

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# How I Found The Gold Coin That Never Was



*And how readers can take advantage of my major gold discovery!*

by Nick Bruyer

Over a thousand years ago my Viking Warrior ancestors raided the coast of England in their great longships, striking terror into the hearts of their victims. But some of them stayed and settled on the Isle of Man, situated between England, Ireland and Scotland. It was during a visit to this ancient Isle that I stumbled onto something amazing—a precious piece of history that you can own and pass down through generations of your own family as a gold treasure of lasting value.

## The Gold Coin That Never Was

As president of an international coin distributor, GovMint.com, I knew that the Isle of Man has its own legal tender coins. So I made a journey to the mint to meet the Mint Master. I was lamenting the fact that there was no gold coin commemorating their Viking heritage, when he told me that such a coin had been authorized, but never minted. The Twentieth Noble was to be struck in 99.99% fine gold. When I asked why it had never been minted, he didn't know. The Mint's official archives did not give a reason, but they revealed a startling fact.

## I Seize a Golden Opportunity

The archives revealed the Government had given the Mint Master the authority to strike the Viking Gold Nobles *at any time*. When I asked if the Mint would strike them now, he agreed, but only if I would purchase the entire mintage. I could hardly believe my good fortune—it was like a dream come true.



Actual size is 15 mm

## The Viking Longboat Gold Noble—Available for the First Time

The Gold Noble depicts a Viking longboat in spectacular frosted relief against a deeply mirrored background. It is double-struck as a Gem Proof, with the flawless surfaces coveted by collectors. As a FIRST-EVER gold coin it is sure to be sought-after.

## Other First-Ever Coins Have Become Highly Prized

First year one ounce China Gold Panda coins were issued in 1982 for less than \$400 each, but today they sell for \$2,999\* each. The first year 1980 one-tenth ounce Proof Krugerrand, sells for up to 20 times more than its gold value. There is no telling what could happen to the value of this Viking Gold Noble in years to come, but you're getting in on the ground floor because *this coin does not yet exist in the collectors market.*

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In times of economic uncertainty, historically, nothing gives peace of mind like gold, and the collector value of this first ever Viking Gold Noble ensures that the coins in this limited edition will sell out rapidly.

Due to the limited supply, orders must be accepted on a first-come, first-served basis at the low original issue price of only \$149.95 each (plus s&h). Order 3 or more at just \$144.95 each (plus s&h) for even greater savings.

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Nicholas Bruyer is an award-winning professional numismatist and author with more than 30 years of coin market experience. Since 1985, tens of thousands of satisfied customers have acquired over \$400 million in coins from his companies. Note: GovMint.com is a private distributor of government and private coin and medallion issues and is not affiliated with the United States Government. Prices and availability subject to change without notice. ©GovMint.com, 2009

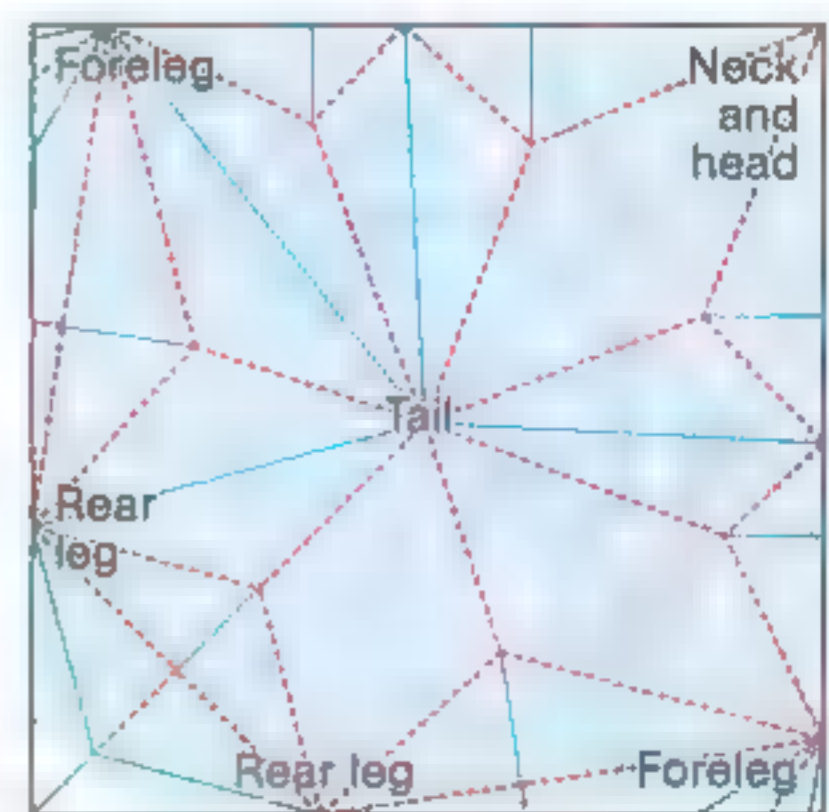
\*All values were accurate at time of printing





**MAPPING THE FOLDS**

Unfolded, Robert Lang’s paper stallion reveals its crease pattern—an origamist’s blueprint (below). Each of the horse’s appendages emerges from a circular region as the paper is flipped over and back along raised “mountains” (blue lines) and indented “valleys” (dashed red lines). Computer programs, including one by Lang, can plot such basic patterns. But the artist added many folds that aren’t shown here to create the final shape.



“Alamo Stallion, Opus 384”

a centuries-old mathematical puzzle: how to pack spheres into a box or circles into a square. Mining the theory allowed origamists to plot complex designs with lots of limbs and also to find technological applications. When engineers working on the design of car air bags asked Lang to figure out the best way to fold one into a dashboard, he saw that his algorithm for paper insects would do the trick. “It was an unexpected solution,” he says.

It was not, however, the first practical application of origami. In 1995 Japanese engineers launched a satellite with a solar array that folded in pleats like a map—an easy-opening kind invented by mathematician Koryo Miura—to fit into a rocket. Once in space, it opened flat to face the sun. Lang has since helped design a space telescope lens the size of a football field that collapses like an umbrella. Only a prototype exists

so far, but even that unfolds to nearly 17 feet.

Researchers are also working at the other size extreme, creating origami stents to prop open arteries and boxes made of self-folding DNA, billions of times smaller than a rice grain, to ferry drugs to diseased cells. Talk to one of these modern origamists and you’ll see a new future unfolding. Someday, says MIT’s Erik Demaine, “we’ll build reconfigurable robots that can fold on their own from one thing into another,” like Transformers. And someday, Lang thinks, all the myriad components of a building might be made from the same simple sheets, folded in myriad ways. “We haven’t reached the limits of what origami can do,” he says. “We can’t even see those limits.” —Jennifer S. Holland



**For a demonstration** of how to make a simple origami figure, go to [ngm.com/bigidea](http://ngm.com/bigidea).

REEDWY



# WOODS

## The Super Trees

*They can grow to be the tallest trees on Earth. They can produce lumber, support jobs, safeguard clean waters, and provide refuge for countless forest species.*

*If we let them.*

*A tagged northern spotted owl swoops toward a researcher's lure in a young natural forest.*



A ragged blanket of coastal fog in northern California masks Humboldt Redwoods State Park as well as old-growth *alongside* smaller forest growth areas outside the park. Redwoods depend on fog for more than 50 percent of their water needs.





*Fourteen stories up a 30-story tree, Humboldt State University scientist Steve Silen (at center) and his team measure a fire cave in a massive redwood in Prairie Creek Redwood State Park. Wildfires have twice burned this tree but failed to kill it.*





*A rare December snow dusts a trail through Del Norte Coast Redwoods State Park. Dependent on a cool marine climate, *Sequoia sempervirens*—the coast redwood—thrives between five and 30 miles inland.*





BY JOEL K. BOURNE, JR.

PHOTOGRAPHS BY MICHAEL NICHOLS

# On a cutover California hillside thick with scrubby redwoods, Scotch broom, and poison oak, Mike Fay missed a step, started to slide, and felt a stiletto jab

the top of his left foot. After bushwhacking hundreds of miles in sandals, he was used to such insults to his 52-year-old feet. But this was the mother of all splinters. It bounced off a bone, lodged in a tendon, and refused to come out. Finally his hiking partner, Lindsey Holm, grabbed it with a pair of pliers and after several sharp tugs, yanked it free.

"You could hear me yelling from mountaintop to mountaintop," Fay says. "It was one of the most painful things I've ever experienced." Which is something coming from a man who was once gored 16 times by an elephant. He taped up the wound, shouldered his pack, and as he had for the past three months, kept walking.

After three decades of helping save African forests, Mike Fay, a Wildlife Conservation Society biologist and National Geographic Society explorer-in-residence, now has redwoods in his blood. His obsession with the iconic American trees began a few years ago after he completed the Megatransect—his Livingstone-like exploration of the largest intact jungle remaining in Africa. (See the October 2000, March 2001, and August 2001 issues.) One day while driving along the northern California coast, he found himself gazing at swaths of clear-cuts and spindly second-growth forests. Another time in a state park, a six-foot-tall slice of an old redwood log on display caught his attention. Near the burgundy center a label read: "1492 Columbus."

"The one that got me was about three inches from the edge," Fay says. "'Gold Rush, 1849.' And I realized that within the last few inches of that tree's life, we'd very nearly liquidated a 2,000-year-old forest."

In the fall of 2007 he resolved to see for himself how Earth's tallest forest had been exploited in the past and is being treated today. By walking the length of California's mythic range, from Big Sur to just beyond the Oregon border, he wanted to find out if there was a way to maximize both timber production and the many ecological and social benefits standing forests provide. If it could be done in the redwoods, he believed, it could be done anywhere on the planet where forests are being leveled for short-term gain. As he'd done on the Megatransect, he and Holm—a self-taught naturalist born and raised in the redwood country of northern California—took pictures and detailed notes on their 11-month trek, exhaustively recording wildlife, plant life, and the condition of the forest and streams. They talked to the people of the redwoods as well: loggers, foresters, biologists, environmentalists, café owners, and timber company executives—all dependent on the forest.

It was an auspicious year to be walking the redwoods. After more than two decades battling environmentalists and state and federal regulators over its aggressive cutting practices, the oft vilified Pacific Lumber Company was bankrupt and up for grabs. Even with most of the remaining old growth protected, the emblematic species

of the great forests—northern spotted owls, elusive little seabirds called marbled murrelets, and coho salmon—continued their dangerous decline, while the reeling economy and housing bust were shuttering sawmills throughout the redwood range. Fires scorched hundreds of thousands of acres in the worst fire season in memory. Tourism was down.

But something else was taking root among the trees Woody Guthrie lionized in “This Land Is Your Land.” The buzz among environmental groups, consulting foresters, and even a few timber companies and communities was that the redwoods were at a historic crossroads—a time when society could move beyond the log/don’t log debates of decades past and embrace a different kind of forestry that could benefit people, wildlife, and perhaps even the planet. The more Fay walked, the more convinced he became.

“California revolutionized the world with the silicon chip,” Fay says, his voice deceptively soft. “They could do the same with forest management.”

**FAY AND HOLM** started their walk at the southern end of the forest, where the trees grow in scattered holdings and groves in the Santa Lucia Range and the Santa Cruz Mountains. Except in small parks like Muir Woods outside San Francisco and Big Basin near Santa Cruz, where they encountered a few rare patches of ancient trees, they zigzagged 1,800 miles through stands that had been cut at least once and many that had been cut three times since 1850, leaving islands of larger second-growth forest in a sea of mostly small trees.

But on a glorious May day, nearly three-quarters of the way into the transect, they arrived at the southern end of Humboldt Redwoods State Park, home to the largest contiguous block of old-growth redwood forest left on the planet—some 10,000 acres. The alluvial flats along its creeks and rivers are prime redwood habitat, where the mix of rich soils, water, and fog rolling in from the ocean have produced the planet’s tallest forest. Of the 180 known redwoods greater than 350 feet, more than 130 grow right here.

Fording a vein of emerald water known as the South Fork of the Eel, they climbed the far bank and entered the translucent shade of the most magnificent grove they’d seen yet. Redwoods the size of Saturn rockets sprouted from the ground like giant beanstalks, their butts blackened by fire. Some bore thick, ropy bark that spiraled skyward in candy-cane swirls. Others had huge cavities known as goose pens—after the use early pioneers put them to—big enough to hold 20 people. Treetops the size of VW buses lay half-buried among the sorrel and sword ferns, where they’d plummeted from 30 stories up—the casualties of titanic wars with the wind, which even now coursed through the tops with panpipe-like creaks and groans. It’s no wonder Steven Spielberg and George Lucas filmed scenes for the *Jurassic Park* sequel and *Return of the Jedi* among the redwood giants: It felt as if a *T. rex* or a furry Ewok could poke its head out at any minute.

Redwoods are no less magical for foresters. Because their bark and heartwood are rich in compounds called polyphenols, bugs and decay-causing fungi don’t like them. And since there’s not a lot of resin in their stringy bark, larger redwoods are highly resistant to fire.

Perhaps the most amazing thing about redwoods is their ability to produce sprouts whenever the cambium—the living tissue just beneath the bark—is exposed to light. If the top breaks off or a limb gets sheared or the tree gets cut by a logger, a new branch will sprout from the wound and grow like crazy. Throughout the forest you can find tremendous stumps with a cluster of second-generation trees, often called fairy rings, around their bases. These trees are all clones of the parent, and their DNA could be thousands of years old. Redwood cones, oddly enough, are tiny—the size of an olive—and may produce seeds only sporadically. As a result, stump sprouting has been key to the survival of the redwoods throughout the logging era.

The trees have another trick foresters love.

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*Contributing Writer Joel Bourne reported on the global food situation in June. Photographer Michael Nichols is an editor at large for the magazine.*

With their high tolerance for shade and ability to sprout, some redwoods can sit almost dormant in the shade of their elders for decades. Yet as soon as a dominant tree falls or is cut down, breaking the canopy and allowing new light to enter the forest, the suppressed redwood springs up with new growth—a phenomenon known as release.

“Redwoods are what’s known in biology as a very plastic species,” says Evan Smith, vice president of forestland for the Conservation Fund. “It’s like a machine. Once you get it going, you can’t stop it.”

**IT COULD BE SAID** that the history—and split personality—of modern America is carved in redwood, with the calls to save the trees reverberating almost as soon as we began cutting them down. For millennia the Tolowa, Yurok, and Chilula tribes, among others, lived behind an almost impenetrable redwood wall more than 300 feet high, eating salmon, elk, and tan oak acorns and carving long canoes from the logs that fell to the ground.

That way of life ended violently in 1848 when the U.S. wrested California away from Mexico and gold was discovered there. Businessmen from the East thought they saw an easier source of riches: the reddish, straight-grained, rot-resistant wood already in high demand in a state that would quadruple its population in a decade. In time the great forests near San Francisco were virtually leveled. Farther north, timber barons used fair means and foul to acquire thousands of acres of federal lands in the redwoods for \$2.50 an acre, beginning an era of corporate lumbering that continues to this day. (Of the 1.6 million acres of redwood forest, 34 percent is owned by three companies, 21 percent by the state of California and the federal government, and the rest by smallholders.) By the 1880s some 400 sawmills north of San Francisco were churning out a mother lode of “sequoia gold,” which for nearly the next century would become an inextricable part of every Californian’s life—from the redwood cradles they were rocked in to the redwood coffins they were laid to rest in.

The 1906 San Francisco earthquake and fires kicked the cutting into overdrive. To meet demand for timber to rebuild the city, logging towns sprang up throughout the redwood range, and companies such as Pacific Lumber and Union Lumber flexed newfound industrial muscles. In place of teams of oxen, portable engines called steam donkeys dragged the massive logs, and narrow-gauge locomotives hauled them from the woods. Grainy photos from the “golden age” of logging show grinning timbermen with mustaches and suspenders standing atop felled trunks the size of Boeing 747s.

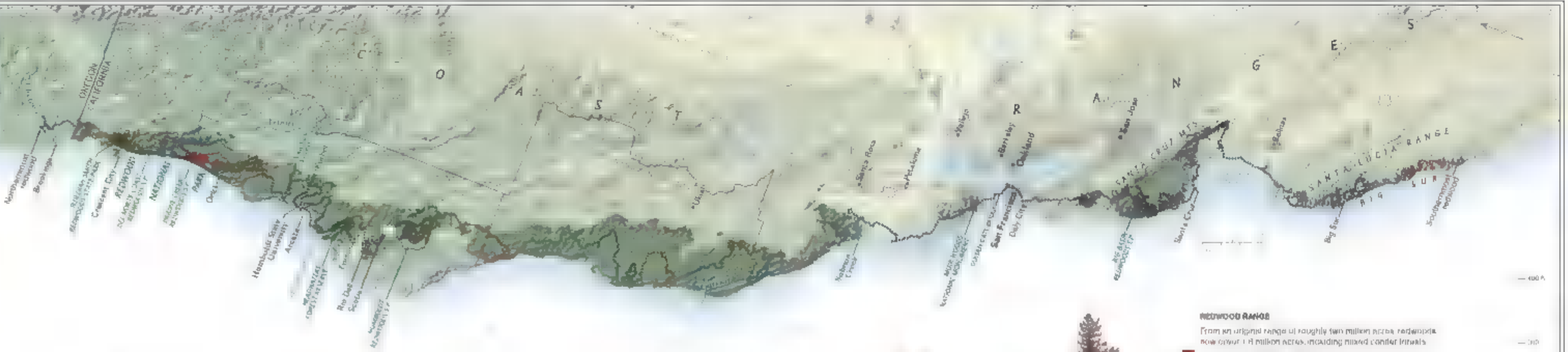
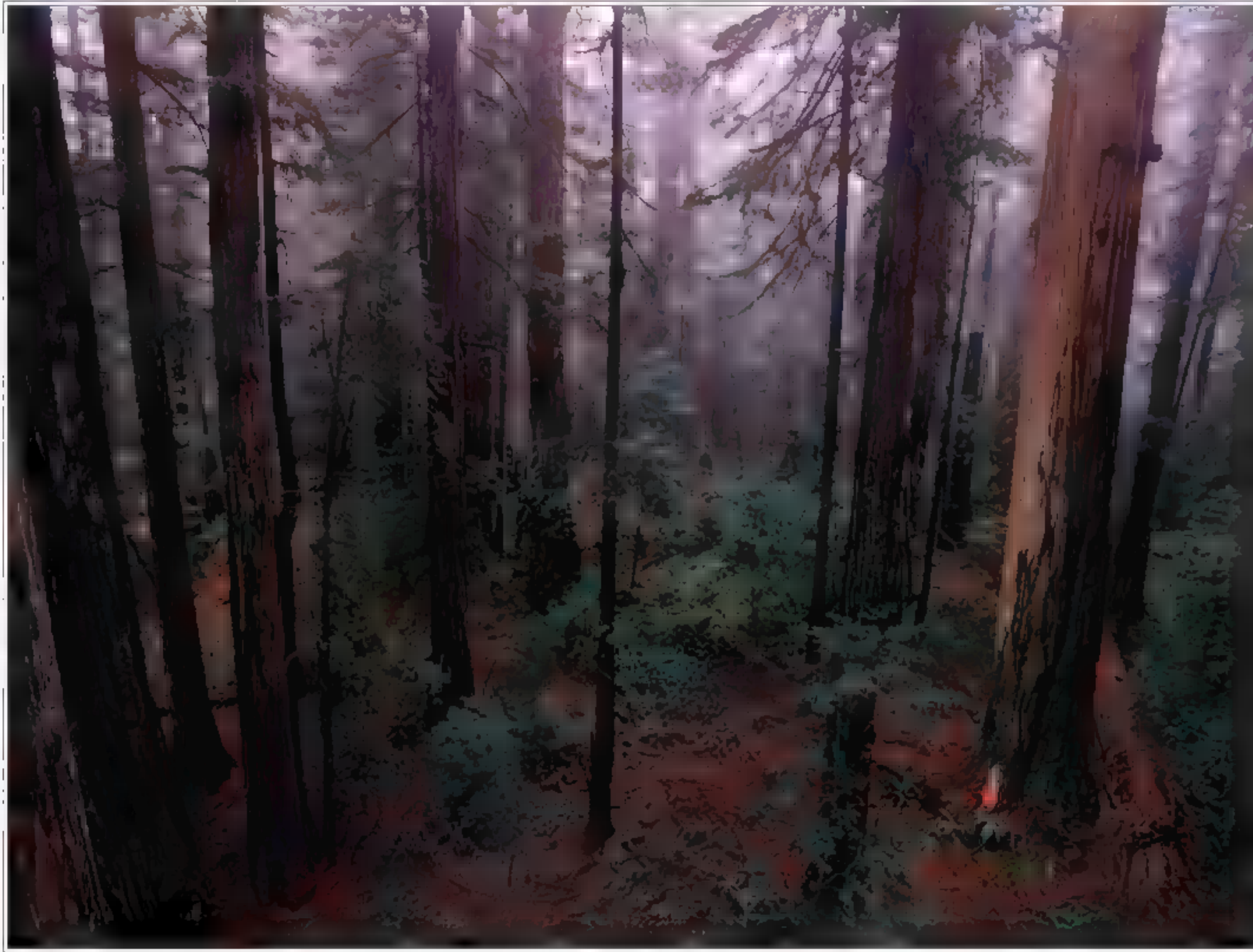
The felling of the great trees also helped spark the modern conservation movement. In 1900 concerned citizens formed the Sempervirens Club, whose advocacy led to the creation of Big Basin Redwoods State Park in 1902. In the 1920s the Save the Redwoods League began purchasing the groves that would become the backbone of California’s redwoods parks, and it continues adding them to this day.

The last, and most intensive, burst of logging began after World War II, when the housing boom and a glut of cheap military-surplus equipment unleashed an army of bulldozers, log trucks, and chain-saw-wielding loggers onto the steep, unstable soils of the redwood forests. By the early 1950s mills were sawing more than a billion board feet of lumber a year, a level maintained until the mid-1970s. (A board foot is the equivalent of a slab of wood one foot square and one inch thick.) Clear-cutting and Cat logging, named after the yellow Caterpillar tractors that became the workhorses of the timber industry, unleashed a torrent of soil into streams from a latticework of logging roads and skid trails. Salmon runs dwindled, and so did other species that had existed in the redwoods for millennia. Today less than 5 percent of the roughly two million acres of virgin forest remains, mostly in parks and reserves throughout the range.

“The battle to save the redwoods has already been fought, and look, we’re left with table scraps,” says Steve Sillett, a forest scientist at Humboldt State University. “The challenge now is understanding how to improve management



At the top of the page, there is a small yellow box with the text: "National Geographic". Below it, there is a small black box with the text: "National Geographic".



## LAST OF THE GIANTS

Redwoods reign only along the Pacific coast, from southern Oregon in Big Sur. The closely related giant sequoia—larger but not taller—lives only in California's Sierra Nevada. During lifetimes that can span millennia, redwoods develop individual architecture, like these resilient giants (right), drawn from precise field measurements made by the artist and other scientists.

California's oldest redwood forest is in the old-growth sanctuary of Humboldt Redwoods State Park (left).



Redwoods nearest the coast—more exposed to storms—develop the most complex crowns. Damage from wind or fire stimulates new growth. Additional trunks ascend from the main trunk and limbs, growing large enough to give rise to more laterals.



The tallest of the tall, rare survivors of logging, grow on land sheltered by ridges or in valleys. Humboldt Redwoods State Park holds more than 130 of the 180 redwoods known to top 350 feet. The current champion, 379.1 feet, was discovered in Redwood National Park in 2006.



More than 95 percent of redwoods are in second- or third-growth forests (right). Most sprout not from seeds but from stumps or roots, reaching 150 feet in less than a hundred years. The rich biodiversity and character of old-growth forests take centuries to form.



**REDWOOD RANGE**  
From an original range of roughly two million acres, redwoods now cover 1.4 million acres, including mixed conifer trunks.

- Old growth:** Fewer than 100,000 acres, less than 4% of the original forest.
- Second- or later growth:** 1.5 million acres.
- Logging:** Permitted on 1.5 million acres, 43% of the range.

**PROTECTED AREAS:** 248,000 acres, 14% of the range (includes public and privately held conservation lands); about 80% of large trees, old-growth and several small trees are protected.

**REDWOOD TRANSECT:** To measure tree growth, Nelfel, Geographic Explorer in Residence Mike Fay and Lindsay Helm walked 1,943 miles in 2007-2008.



on the 95 percent of the redwood landscape that's just starting to grow.”

**SALMON AND SPOTTED OWLS** aren't the only things to have suffered with the felling of the forest. Harvest rates in the redwoods have plummeted since the 1990s, when they were already half what they were in the 1970s. Though Fay and Holm spent nearly every night under the stars, every two weeks they'd hit little logging towns to recharge computer and camera batteries and download their data on portable hard drives—places like Korb and Orick that once boasted several sawmills but are now lucky to have one still limping along. Rio Dell, a town of 3,200, has been luckier than most. It sits across the Eel River from Scotia, home to what was once a venerable timber enterprise: Pacific Lumber Company.

Last year more than the typical thick, gray clouds were hovering over Rio Dell's Wildwood Days, the annual street festival replete with logging contests, bocce tournaments, and bucket brigade races between local volunteer fire departments. Days earlier, after a protracted fight in federal bankruptcy court, PL (as the company is known here), employer of generations of the two towns' mill workers and woodsmen, had been sold. The future was now in the hands of Mendocino Redwood Company (MRC), owned by the Fisher family of San Francisco, who had made their fortune with the Gap and Banana Republic clothing chains. The only thing most people in Rio Dell knew was MRC's new incarnation of the old Pacific Lumber operation: Humboldt Redwood Company (HRC). No one knew who would have jobs when the dust cleared.

Down at the logging contest—featuring an event in which two men see who can cut a log faster with chain saws—Len Nielson of Fortuna just beat out Chris Hall of Rio Dell, a big man with a shaved head, a neat, red goatee, and a tattoo that read “HOSS” across his Popeye-like forearm. All told—grandfather, dad, uncles, and cousins—Hall's family had spent 142 years working for PL. He'd been felling trees, driving

## Redwoods the size of Saturn rockets sprouted from the ground like giant bean- stalks, their butts blackened by fire.

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Cats, skidding logs since he was 15. Now he works in the power plant.

“We're definitely glad to see Hurwitz go,” Hall says, as he puts away his chain saw, with his five-year-old daughter dancing at his feet.

It's hard to have a conversation about forestry practices in the redwoods without hearing the name of Charles Hurwitz, CEO of Houston-based Maxxam, Inc. In 1985 Hurwitz orchestrated the hostile takeover—underwritten by junk bonds provided by the financier Michael Milken—of Pacific Lumber, which had been run conservatively by the Murphy family since 1905. By leaving some of their old growth standing, the Murphys, men who learned the lumber business from the chain saw up, had planned to sustain their timber harvest and jobs well into the 21st century. “When the Murphys owned PL, they cared for their employees,” Hall says.

With Pacific Lumber, Hurwitz inherited roughly 70 percent of the remaining old redwoods in private hands. In his first meeting with the employees, the dark-suited businessman told them—in a now famous quote—that he believed in the golden rule: “He who has the gold, rules.” Hurwitz then proceeded to break up the company and sell its assets. He sold Pacific Lumber's office building in downtown San Francisco and a profitable welding division, and he cashed out the workers' pension fund, replacing it with an annuity from a poorly rated insurance carrier.

Most important for the redwoods, Hurwitz adopted a business model of clear-cutting, doubling—and some years even tripling—the annual amount of timber harvested from



# INTO THE WOODS

*National Geographic Explorer-in-Residence Mike Fay emerges from a hellish hike down Little Lost Man Creek in Redwood National Park. In 2008 Fay and hiking partner Lindsey Holm finished the first comprehensive transect of the redwood forest covering 1,800 miles of Pacific coastal forest.*

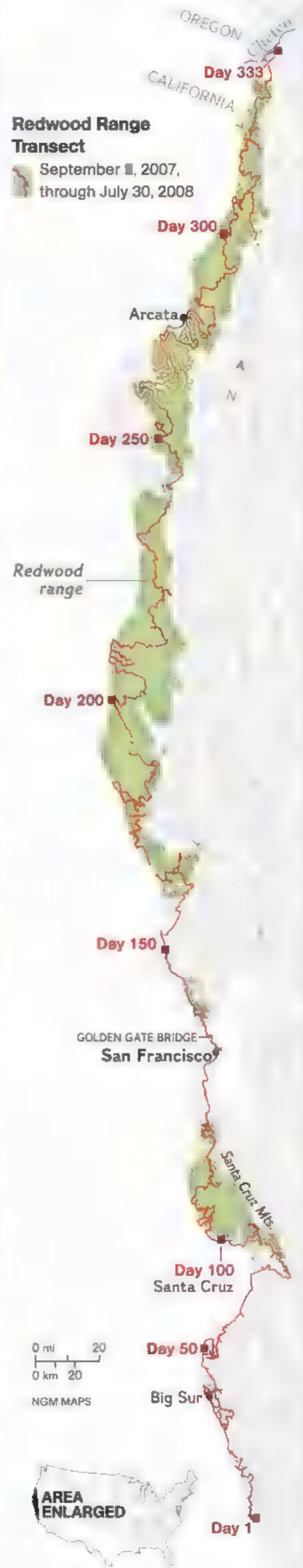
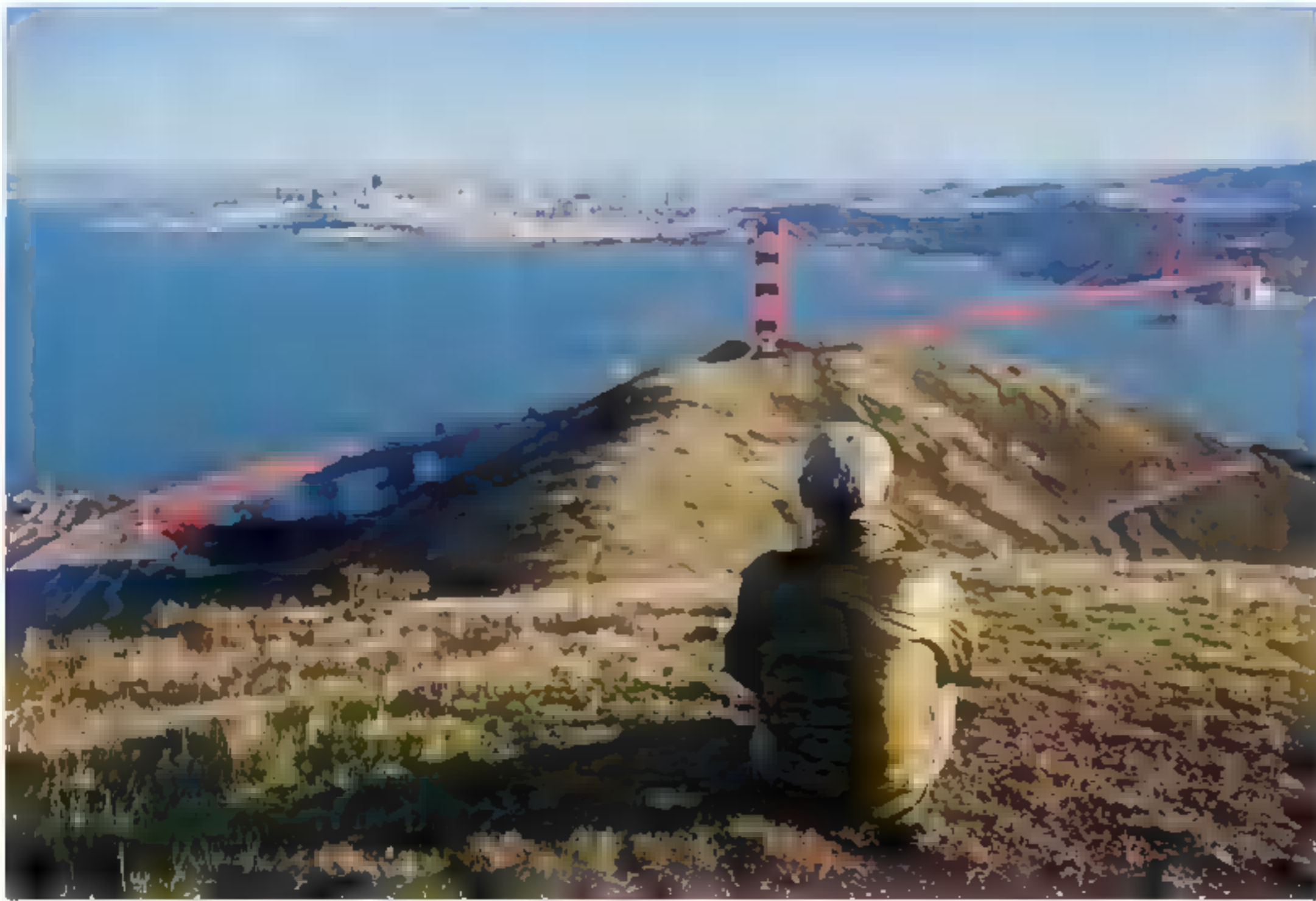




*From the southernmost redwood in Big Sur to the northernmost tree near Oregon's Chetco River, Mike Fay and Lindsey Holm spent almost a year walking the redwoods (map, far right), stopping often to record plants, animals, and forest conditions around them. They passed through the birthplace of redwood logging in the Santa Cruz Mountains (top left), through San Francisco, rebuilt with redwood timber after the earthquake and fires of 1906, and across the Golden Gate Bridge (top right). Hauling laptops, hard drives, and cameras in 60-pound packs, they used the woods as their office and springs and rivers as their faucet and bathtub (middle left). Their focus was forest management, whether noting the size of a truck-load of logs (middle right), checking out a burn pile in a clear-cut (bottom left), or looking for marbled murrelets up high in old growth (bottom right). "In 20 years we won't think of logging these lands like we do today," Fay says. "Our knowledge of these forests is constantly evolving."*

**Society Grant** The Redwood Transect was funded in part by your National Geographic Society membership. Additional support came from Wildlife Conservation Society and Save the Redwoods League.





the company's holdings, which eventually reached 210,000 acres. His attempts to cut the largest remaining block of old growth on private land, known as the Headwaters Forest, launched an army of young protesters into the streets and up the trees and drew increased scrutiny from state timber regulators and federal wildlife agencies. For forest defenders, as the protesters call themselves, it was a dangerous time. Tree sitters were extracted by force from their platforms hundreds of feet in the air. The late Judi Bari, one of the organizers of a series of protests in 1990, a time known as "redwood summer," had her pelvis shattered by a pipe bomb placed in her car. No one was ever charged in the crime.

In 1998 David "Gypsy" Chain and some other protesters hiked out to a PL tract where they believed loggers were building roads before the end of the marbled murrelet nesting season, when logging is illegal. One logger, caught on videotape, cursed them, saying he wished he'd brought his gun. Then he felled a redwood in their direction. The tree struck Chain in the head, killing him instantly. The logger was never charged. In 1999 the state and federal governments purchased part of the Headwaters Forest, putting it under permanent protection.

**THE DAYS OF** violent confrontations seem to be over now. A week after MRC's acquisition of Pacific Lumber, Mike Jani, the company's president and chief forester, asked Fay and Holm to join him and local activists at the foot of a redwood giant just across the Eel River from Rio Dell. Protesters had occupied part of an old-growth grove here for years to keep PL from logging. Jani told the activists that under the new company's policies the trees would not be taken, and "Do Not Cut" flagging was put up around the survivors.

"Fighting for old growth is easy," Lindsey Holm told me. "It's a moral issue, black-and-white. Save the old trees—the endangered species. It's a no-brainer." Trying to rally people around sound second-growth forestry is more challenging—more about keeping the ecosystem intact by minimizing erosion and maintaining

wildlife while maximizing timber production. For most Californians, clear-cuts are bad forestry because they're ugly. That misses the point, said Holm, who isn't necessarily averse to clear-cuts. "This is about good forestry, not about what you can see out your kitchen window."

The notion that you can log a forest without leveling it isn't new. As early as the 1930s Emanuel Fritz, a forestry professor at the University of California, Berkeley, argued that if timber companies wanted to be in business in 40 to 50 years—the time he estimated it would take to cut all the remaining old-growth forest—they'd better start leaving some trees for the future. In line with this thinking, Albert Stanwood Murphy decreed that Pacific Lumber would never cut more than 70 percent of a stand of timber or cut more from its forests than would grow in a year—policies the company held for more than half a century until Charles Hurwitz tossed them out.

Now Jani promises that the new Humboldt Redwood Company will bring selective cutting back to the old Pacific Lumber lands. Its parent company, MRC, has already implemented the approach on 230,000 acres of heavily logged redwood forest in Mendocino County it purchased from Louisiana Pacific a decade ago. MRC stabilized logging roads, reestablished stands, and made a practice of cutting a third to a half of the overall volume of timber grown on its property each year through a variety of selection techniques. By doing this, the company has sacrificed greater short-term profits for long-term investment in the forest.

Scott Greacen, executive director of a local group called the Environmental Protection Information Center (EPIC), is watching closely to see how HRC manages its new holdings. However, when Fay and Holm visited Greacen at the EPIC office in downtown Arcata, the maps of PL timber-harvest plans had been replaced by those of another large industrial landowner: Green Diamond Resource Company.

Green Diamond is now the largest clear-cutter in the redwoods, with more than 70 percent of its 430,000 acres given over to uniform stands that

are logged roughly every 50 years. When asked if the company was EPIC's next target, Greacen says, "I think we're going to have something to say about short-term, even-age forestry."

**"HERE WE LOVE** even-age forests," says Greg Templeton, one of Green Diamond's veteran foresters. "Both redwoods and Doug fir grow faster in full sunlight." He was standing on a hot, sunny hillside, watching with pride as a logging crew reduced a 70-year-old stand of 150- to 200-foot redwoods into an organized tangle of slash, limbs, and logs.

In the 1990s California reduced the maximum allowable size for a clear-cut from 80 acres to between 20 and 40. The heavy tractors that caused so much erosion have largely been replaced by smaller, lighter shovel loaders—tracked machines that look like old-fashioned steam shovels with an articulated grapple on the end. By picking up entire logs instead of dragging them on the ground, shovel loaders eliminate the erodible skid trails that were the hallmark of Cat logging and the bane of salmon-spawning creeks. For target trees on steep hillsides, foresters use a cable yarder, a setup that hoists cut logs along a cable running from a tall tower placed at the top of the hill to a massive stump on the opposite slope. According to Templeton, the switch to such machinery, along with fewer, better-built logging roads and mandated buffer zones along streams (where some selective cutting is allowed), significantly reduces sediment going into salmon-spawning waters.

Green Diamond's puzzle-piece forests, with blocks of tightly packed small trees up to 20 years old separated by slivers of older trees in the 150-foot buffer zones around fish-bearing streams, will ultimately provide good wildlife habitat, says Neal Ewald, the company's vice president and general manager. "Fifty years from now 20 percent of this landscape will stick up like veins on a maple leaf, with a network of old trees around the streams," he explains. "We're on target to create the same kind of trees you see in Redwood National Park in a hundred years," to the benefit, he says, of salmon and northern spotted owls.

## Clear-cutting and Caterpillar logging unleashed a torrent of soil into streams. Salmon runs dwindled, and so did other species.

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In the early 1990s Green Diamond's senior biologist, Lowell Diller, was among the first to find high densities of spotted owls in second-growth forests. His research indicated that the owls can survive in the smaller forests as long as they have enough old snags and large trees with cavities and platforms for nesting. And the mix of young forest blocks of various ages created by clear-cuts provides good habitat for dusky-footed wood rats—the owls' favorite prey in California.

Diller's findings helped Green Diamond secure the first Habitat Conservation Plan (HCP) for spotted owls from the U.S. Fish and Wildlife Service in 1992, which allowed the company to continue logging in spotted owl territory as long as they had a plan to maintain a minimum amount of owl habitat. Yet owls have been declining by about 3 percent a year on Green Diamond lands since 2001, Diller says, as they have over much of their range.

Part of the problem is a mysterious drop in the wood rat population, as well as increased competition from the more aggressive and adaptable barred owl, which has muscled into the spotted owls' territory from the east.

Young forests have shown other unintended wildlife consequences. In spring, before berries and acorns come in, black bears depend in part on the sap just under the bark of redwoods and other conifers. They prefer the young, fastest growing trees and have done so much damage to commercial stands that some foresters call them the biggest "pest" in the redwoods. But bears became a problem only when companies began growing trees like a crop.



Ray "Old Growth" Wood makes the undercut on a redwood 30 inches in diameter—a sapling compared to the 13-footers he cut as a young man. "It's boom and bust," 67-year-old Wood says of the log market, now at its lowest point in a decade.





**AFTER WALKING** through every kind of managed forest and talking to foresters on all sides of the issue, Mike Fay is convinced there's a better way: Grow bigger trees, which can maximize wood production while providing good habitat. "You've got to start thinking about this as an ecosystem," he says. "All these plantations might as well be growing corn. But if you want clean water, salmon, wildlife, and high-quality lumber, you've got to have a forest."

Fay is not alone. "My idea is to cut less trees and make more money per tree," says Jim Able, a former industrial forester for Louisiana Pacific who now manages small private timberlands, most fewer than a thousand acres. Wearing his trademark straw hat, Able leads Fay through the Howe Creek tract, a timber plot he's managed for nearly three decades and is thinning for

the third time. Douglas firs and large second-generation redwoods, three or more feet thick and up to 200 feet tall, rise from the steep hillside straight as arrows. Here and there a few trees lie on the ground, waiting to be yarded, creating a mosaic of shadow and sun. The key, Able says, is form. He and his foresters mark every tree they want cut, aiming never to exceed 30 to 35 percent of the volume of the stand. Unlike high-grading, a form of selective logging that Able considers worse than clear-cutting because it takes the best and leaves the rest, Able cuts weak and poorly formed trees, leaving the straightest and strongest to thrive in the newly available light. And unlike timbermen who harvest clear-cuts every few decades, Able comes back once a decade to evaluate whether to cut again. He never takes more





*Laughter cheers the struggling Humboldt County lumber town of Rio Dell as kids get splashed during the annual Wildwood Days fair. Local unemployment hit a 16-year high this March. With timber demand down, Humboldt Redwood Company will cut just a third of its planned 2009-2010 harvest.*

wood than the forest has grown over that time, which means that the remaining trees—what he calls his principal—continue to increase in height, volume, and quality.

“What I’m doing is growing old trees and taking the interest in the interim,” he says. “I firmly believe I can keep doing this over a hundred years.”

More landowners are following in Able’s footsteps, growing their redwoods older and cutting them more sparingly. Some call this ecological forestry, in which the forest is managed to provide wildlife habitat and clean rivers as well as forestry jobs and wood products. The 2,200-acre van Eck Forest near Arcata, managed by the Pacific Forest Trust, serves an additional purpose: It earns some of its keep by providing greenhouse gas reductions,

## Redwoods produce more wood, and better wood, as they age. Sillett thinks this may be true for other trees around the world.

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which can be used to offset emissions. Thanks to their phenomenal growth, resistance to disease, insects, and rot, and their incredibly long lives, redwood forests are the best of all forests at capturing carbon dioxide from the atmosphere and locking away the carbon in their wood. California’s voluntary market for forest landowners is among the most rigorous in the world. The market allows owners to sell credits for the carbon stored in each year’s grown wood as long as they guarantee to maintain that growth for a century.

Money for carbon stored in living trees could help landowners make the transition from short-term clear-cuts to long-term rotations where bigger, higher quality trees could once again dominate the landscape. So far, based on the amount of carbon the van Eck is estimated to sequester over a hundred years, the Pacific Forest Trust has sold more than two million dollars’ worth of emissions-reduction credits.

Another group practicing ecological forestry, Evan Smith’s Conservation Fund, bought 40,000 acres of industrial timberlands in the Garcia River, Big River, and Salmon Creek watersheds to keep the trees from becoming vineyards and subdivisions. The organization plans to use uneven-age selection forestry to restore aquatic habitat by reducing erosion into the streams. To help with financing, it is selling millions of dollars’ worth of carbon-reduction credits to Pacific Gas and Electric Company as well as to several investment firms.

California’s Air Resources Board now plans to adopt an updated carbon protocol for forestry, hoping to attract (Continued on page 58)



*Roosevelt elk cows scatter across a meadow in Prairie Creek Redwoods State Park as two bulls vie for dominance in the herd. Largest in North America's elk subspecies, their name honors conservationist President Theodore Roosevelt.*





*A black bear saunters past a camera trap set by photographer Michael Nichols. When more nutritious foods are scarce, bears often strip the bark off young redwoods to get at the sap below, wreaking havoc on regrowth in timberlands.*



# FORESTS IN THE AIR

*Hundreds of feet above the ground, the crowns of ancient redwoods shelter another forest. Thickets of berry bushes, ferns, and other conifers—some large enough to bear cones—rise from dense mats of soil on broad limbs or in trunk forks. The soil, as thick as three feet, forms from decayed leatherleaf ferns and redwood leaves and bark, nourishing an aerial ecosystem unknown until the 1990s, when scientists first climbed into the canopy.*

## MARbled MURRELET

The endangered web-footed seabird nests in the crowns of large conifers in old-growth forests, flying as far as 50 miles between nest and Pacific to feed.

STELLER'S  
JAY

REDWOOD  
TRUNK  
GROWING  
FROM LIMB

LEATHERLEAF  
FERN

EVERGREEN  
HUCKLEBERRY

SALAMANDER



SEAN MCNAUGHTON, NG STAFF, DITA SMITH  
ART BY AMADEO BACHAR  
SOURCES: STEVE SILLETT, HUMBOLDT STATE  
UNIVERSITY, GEORGE KOCH, NORTHERN  
ARIZONA UNIVERSITY



## HOW THE TALLEST TREES DRINK

As water evaporates from leaves, more water is pulled up in a continuous chain. Special aspects of redwood cells may help water keep rising against gravity to extreme heights. Leaves also absorb water directly from rain and fog.

## CANOPY PREDATOR

Climbing from the forest floor, the wandering salamander may stay in the canopy, hunting insects and other invertebrates. Lacking lungs, its body must remain moist to allow it to breathe through its skin.



RED HUCKLEBERRY

WESTERN HEMLOCK

YELLOW-CHEEKED CHIPMUNK

B COPEPODS

C FUNGI

**Canopy Soil**  
Soil mats can store enough water to sustain a canopy community during the summer. The tree itself may benefit by drawing water and nutrients through roots sent out by its additional trunks that rise from limbs.



**UNEXPECTED RESIDENTS**

Barely visible, aquatic crustaceans called copepods live in soil mats far above their usual home in streams. Needing only a thin film of water to move, they likely swim up redwood trunks during storms.



**PARTNERSHIP**

Fungi colonize the roots of woody plants in a symbiotic relationship, helping plants absorb nutrients and water. Fungi also speed decay of dead vegetation to produce canopy soil.







Partway in a 350-foot tree, botanist Marie Antoine (at right) passes a slender sample of its wood—750 years of redwood biography—to canopy ecologist Giacomo Renzullo. Research now shows that the older each tree gets, the more wood they put on.

“California revolutionized the world with the silicon chip. They could do the same with forest management,” Mike Fay says.

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(Continued from page 49) the industrial timber owners. “If we can get the carbon incentives right, we can double or even triple our inventory in the redwoods,” Mike Fay says.

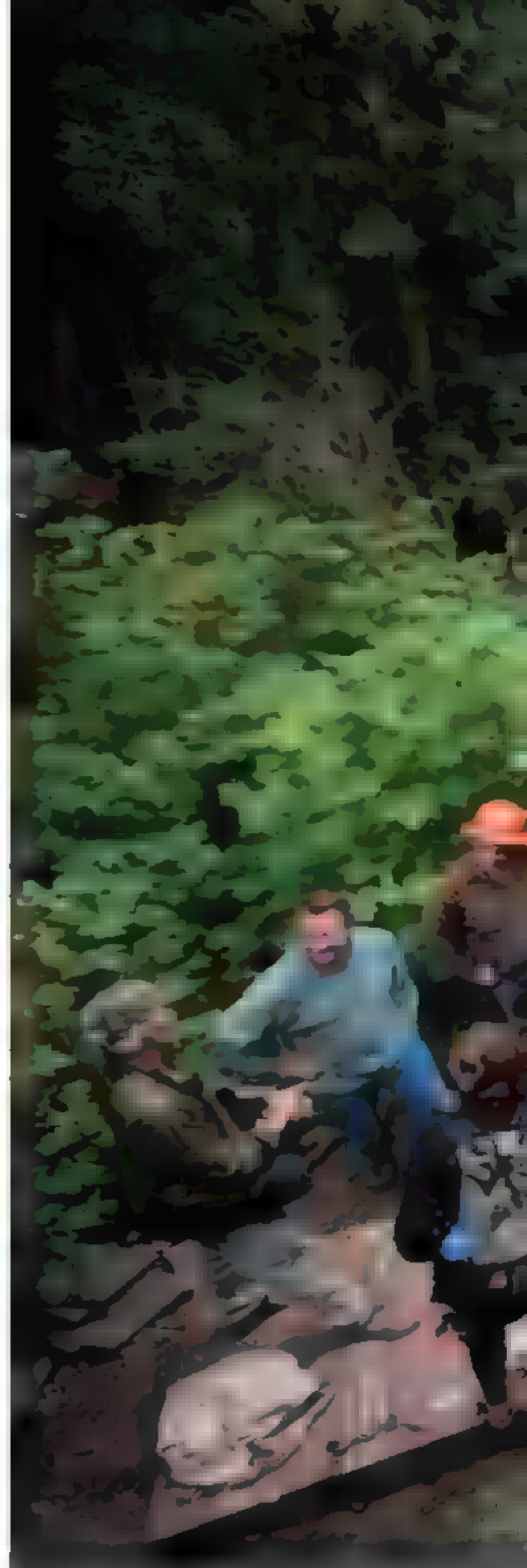
**ON A DAY WHEN** the early morning sun is filling the mist-shrouded canopy of Prairie Creek Redwoods State Park with an iridescent glow, Mike Fay hooks his ascender to a climbing rope and “jugs” up a truly massive redwood to talk to one scientist who is convinced of the value of letting redwoods grow big. Steve Sillett has made a name for himself by finding, climbing, and studying the tallest trees on the planet. He has meticulously measured hundreds, from their mighty bases right up to the individual needles at the top. At 138 feet up, Fay passes a fire cave big enough for two grown men to stand in amid a thicket of reiterated trunks and branches—battle scars from centuries of skirmishing with fire and wind. Higher still, epiphytic ferns and huckleberry bushes grow in deep canopy soils, while a myriad of mosses, liverworts, and lichens cover the bark. This tree, at 301 feet, isn’t even close to the world’s tallest, at 379.1, but according to Sillett, who is waiting for Fay at an opening in the canopy right at the very top, it is “super juicy”—loaded with canopy soils and biodiversity. From there the two men peer out upon a nearly unbroken expanse of huge redwoods, with one clear-cut barely visible to the south.

The mantra of industrial foresters has long been to grow trees as fast as possible to maximize the return on investment and provide a steady flow of wood products to market. For them, the

*Laying hands on an old friend, activist Amy Arcuri shows her delight in Spooner, a giant she says is nearly 2,000 years old. Once slated to be cut, the tree has been declared off-limits by its new owner, Humboldt Redwood Company. “I try to believe there can be progressive change,” Arcuri says.*

most profitable time to cut redwoods is at 40 to 50 years, even though such young trees contain mostly soft, low-quality sapwood, with little of the redwoods’ legendary resistance to rot. But after coring and measuring two dozen trees—95 feet to 370 feet tall—from canopy to base in Humboldt Redwoods State Park, Sillett discovered that a tree’s annual rate of wood production increases with age for at least 1,500 years. More important, the older it gets, the more high-quality, rot-resistant heartwood it puts on. The bottom line: Redwoods produce more wood, and better wood, as they age. Sillett says this is true for the tallest eucalyptus trees in Australia too, and he thinks it may be true for other trees around the world.

“If it’s all about short-term yield, there’s not an effective argument for big trees,” Sillett says.





“But if it’s about long-term yield, carbon sequestration, and ecosystem services, then you’ve got an effective argument for old trees. What do we need to remove and keep lots of carbon out of the atmosphere? Massive amounts of decay-resistant wood.”

**ON THE LAST DAY** of their transect, as they hunted for the northernmost redwood near Oregon’s Chetco River, Mike Fay and Lindsey Holm talked about the characters they’d met in the forest. There were Lud and Bud McCrary, octogenarian brothers who pioneered uneven-age forestry in the Santa Cruz Mountains—Lud’s family even built a redwood bomb shelter after the Cuban Missile Crisis in 1962. And there was the story of Tim Renner, a veteran logger with a hearty dislike for forest activists. Renner told about the

time he had been hired to cut some trees in the Arcata Community Forest, a selectively logged tract near town that also serves as a community park. He was putting away his chain saw at the end of a day’s work when a young man came walking down the trail with long hair, a long beard, and dirty clothes. And Renner thought, This kid is going to chew me up.

The young man stopped and looked at the freshly cut forest, and to the logger’s astonishment, he said, “This looks great! There’s so much more light coming in. I really like the way this looks.”

Which means that along with high-quality wood, carbon storage, clean water, and wildlife habitat, ecological forestry can bring back another benefit for which redwoods are justly famous: utter awe. □

# THE REDWOODS POINT THE WAY

*A conservationist sees a new wave of enlightened forestry as a model for wiser stewardship of nature.*

## ESSAY BY J. MICHAEL FAY

**ON DAY 323** of the transect, in Jedediah Smith Redwoods State Park, I dropped over a log 18 feet in diameter into an abyss of giant botanical pickup sticks, deadfall that had piled up amid the living trees over thousands of years. Another fallen monster loomed. Grabbing huckleberry roots and clumps of sword ferns, I hauled myself and my 60-pound pack up its organic wall onto a trunk as long as a football field. Filthy and exhausted, surrounded by hundreds of towering redwood columns that were raining their captured fog on my head, I stood there overwhelmed by a scene straight out of the Jurassic.

I've been walking in forests for 40 years; never could I have imagined a woods as grand as this.

Staring skyward through the somber silhouettes, I thought about the timberman who had described his company's patchwork of clear-cuts, with their sun-drenched mix of tiny trees interspersed with strips of older redwoods, as functionally the same as an old-growth forest. No amount of persuasive conversation or data will ever convince me of that. This isn't about loving big trees. It's about the fact that I spent 333 days

walking 1,800 miles through the entire range of the redwoods with a notebook in my hand, documenting details about this ecosystem—and witnessing the aftermath of the cutting of at least 95 percent of the most wood-laden forest on Earth.

Timber folks know the history—most I met in redwood country used words like nuked, hammered, blitzed, wasted, and raped to describe the logging of the past. The landscape bears them out. I spent too many days on the transect pushing past gigantic stumps, through weedy stands of small trees amid crumbling road systems, over eroded hillsides, and across rivers choked with gravel and silt, whose fisheries had collapsed. It was a landscape shaped by greed and waste.

The time to argue about the wisdom of liquidating the resource base of the planet is over.

In the redwoods I found many who agree. Dave Lewers, whom I joined on the 12,000-acre Flat Ridge Ranch he meticulously manages in Sonoma County, said it best: "They might think I'm a gun-toting, right-wing redneck, but what they have to understand is, they've got our attention." The "they" are environmentalists and state regulators, and what Lewers meant was that he is a frontline participant in efforts to restore the redwood forest.

All along the transect I met foresters, owners,

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*J. Michael Fay is a conservationist and senior explorer at the Wildlife Conservation Society and a National Geographic Society explorer-in-residence.*



GLASS PLATE: ERICSON COLLECTION, HUMBOLDT STATE UNIVERSITY LIBRARY  
THIS PHOTOGRAPH IS REPRODUCED AS A NEGATIVE TO SHOW THE GLASS IMAGE AS A POSITIVE.

*A glass-plate negative from the 1890s, held by Edie Butler of Humboldt State University, records one of countless fallen giants. Only a fraction of the original redwood forest remains.*

and loggers who talk as if they've discovered the holy grail of redwood management. People like Jim Able, Jim Greig, and Ed Tunheim who have found a way to bring vigor back to this ecosystem—and stay in business at the same time. What they're learning, and how they're applying that knowledge, can serve as a blueprint for the entire redwood range. Their ability to supply large amounts of lumber for humanity and improve ecosystem function is an approach that should be adopted around the world.

In brief: These veteran foresters are carrying out a form of single-tree selection that is more

productive in the long term than clear-cutting. Every 10 to 15 years they take about a third of the timber in a stand, going for the least robust trees—the runts, as Jim Able calls them. This creates more open space, allowing the remaining trees to get a greater share of the sunlight, which speeds their growth. Every year the amount and quality of the standing wood increase, and because regeneration happens gradually, the process can proceed for centuries. The advantages are twofold: short-term income and a larger payback over the long term. "You can't be greedy or in a rush," Ed Tunheim says.

This isn't just about wood. Past damage to ecosystems is being repaired. Sediment is being excavated from streams to restore their original beds, and culverts enlarged to permit natural stream flow. Thousands of logs are being placed



in creeks to create fish habitat. Roads are being recontoured and reinforced or simply erased from the landscape. Along rivers and in slide-prone areas, timber harvests are being reduced. Trees identified as crucial for wildlife habitat—and remnant old growth—are being preserved.

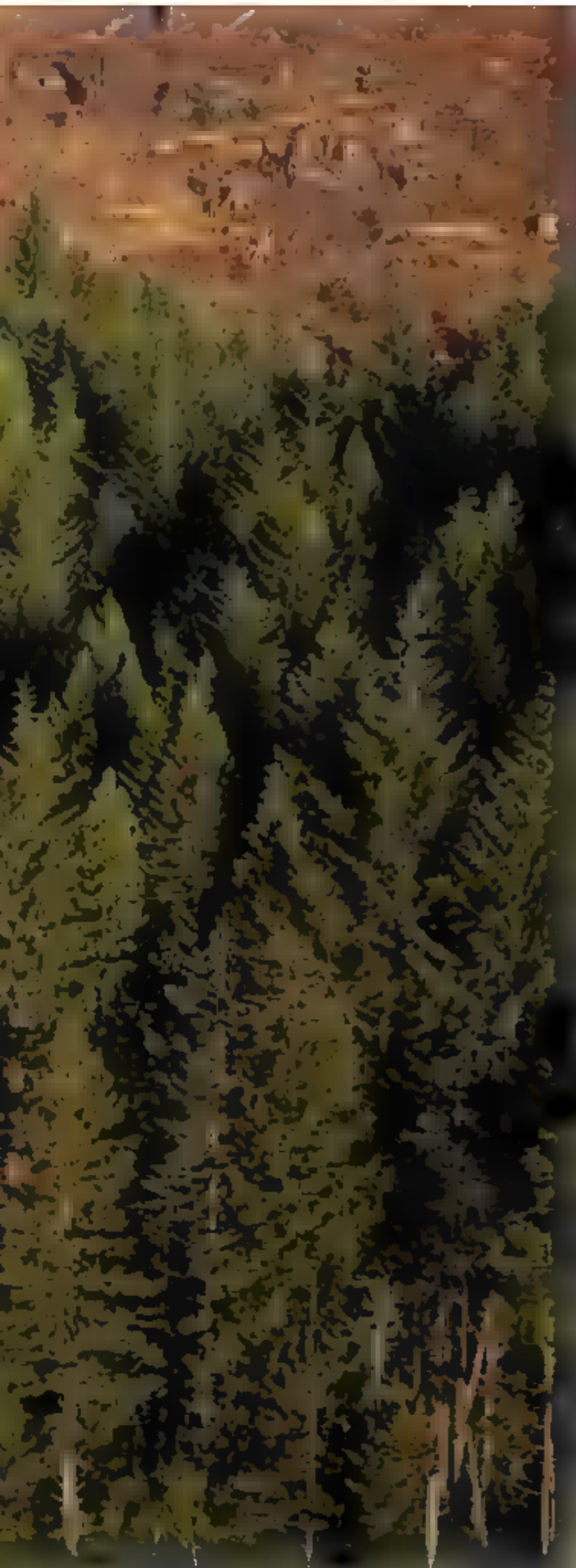
The next quantum leap is the idea that we can, and should, put a dollar value on the environmental assets of the forest. Already, some timber owners, helped by grants from voter-approved initiatives, are going above and beyond what state regulations require in rehabilitating watersheds, decommissioning roads, and stopping erosion. These investments reduce their maintenance costs and help the bottom line while guaranteeing benefits such as cleaner water and healthier fish populations.

Especially promising is the idea that because

forests absorb the greenhouse gas carbon dioxide, timber owners should be paid for the carbon accumulated in their trees. The redwood forest, with its vast carbon-storage capacity, is where many of the first carbon sales have occurred. As new state and federal climate regulations take effect, this market will grow, along with the incentive for timber owners to maximize the standing volume and the productivity of their forests, which produce higher quality lumber the older they get.

The time is right to embrace a systematic plan of recovery for the entire redwood forest—all the pieces are now in place.

**THE REDWOODS** hold a broader lesson. In 1908 President Teddy Roosevelt brought together the governors of 39 states and territories, the



*Clear-cuts eat into stands of 55-year-old spruce, fir, and redwood trees on Green Diamond company land in Humboldt County. California regulations require companies practicing such even-age management to leave buffer zones between cuts and around streams.*

Supreme Court justices, virtually his entire Cabinet, and members of Congress and 68 professional societies. Never before or since has such a powerful group been assembled in the White House. Opening the conference, Roosevelt said, "You have come hither at my request... to consider the question of the conservation and use of the great fundamental sources of wealth of this Nation... It is the chief material question that confronts us."

The President tallied the toll on America's resources, including the loss of half our original timber. He made an eloquent call to rebuild the nation's natural capital, or face hardship. He implored those in position to exploit nature for excessive profit to take the moral high ground instead of robbing future generations.

At that time, a century ago, there were only

about 300,000 white-tailed deer left in the entire United States. Today, even though the human footprint has increased exponentially, there are perhaps 30 million. This rehabilitation, in which states managed hunting, reintroduced the animals in hundreds of places, and restored habitat, has been so successful that many now consider whitetails a pest. The deer story Roosevelt helped inspire is a clear and simple demonstration that conservation can vastly increase the renewable resources we've hammered and wasted since Europeans arrived in North America.

Here is my message: President Obama, convene your own White House conference. The objective would be to build on what's being done in the redwoods and design a Marshall Plan for the proper use of all the natural assets in the United States. People will try to dissuade you, saying we can't possibly afford to think about saving nature when the world is mired in an economic crisis, confronting wars and the threat of nuclear terrorism. President Roosevelt, too, had his challenges—Japan and Russia at war, monopolists to control, the Panama Canal to build—but he understood that conservation was the principal material question facing humanity.

In the 21st century, as we face the consequences of global warming, this is even more vitally true. We need to generalize this simple notion: Rebuild our natural capital thoughtfully and reap the benefits. With increased production for humanity also come healthy ecosystems and global balance. We can—and must—do this not just with our forests and wildlife but also with the fish in our oceans and streams, the soils on our farms, and the grass in our pastures. The redwoods can show us the way. □



**Climbing Redwood Giants**—a saga of discovery in the world's tallest trees—airs on **National Geographic Channel, September 29 at 10 p.m. ET in the U.S.**

For behind-the-scenes video of how Nick Nichols made his unprecedented photographic portrait of a redwood and for more on Mike Fay's transect, go to [ngm.com/redwoods](http://ngm.com/redwoods).



They're rarely seen. Even less often photographed.

# IN HOT





# PURSUIT

Bryde's whales rocket through Pacific shallows to gorge on fish.

Packed fin to fin,  
thousands of panicked  
mackerel dodge a raft  
of hungry sea lions and  
a 40-foot-long Bryde's  
whale on the hunt along  
the coast of Mexico's  
Baja Peninsula.

BRANDON COLE



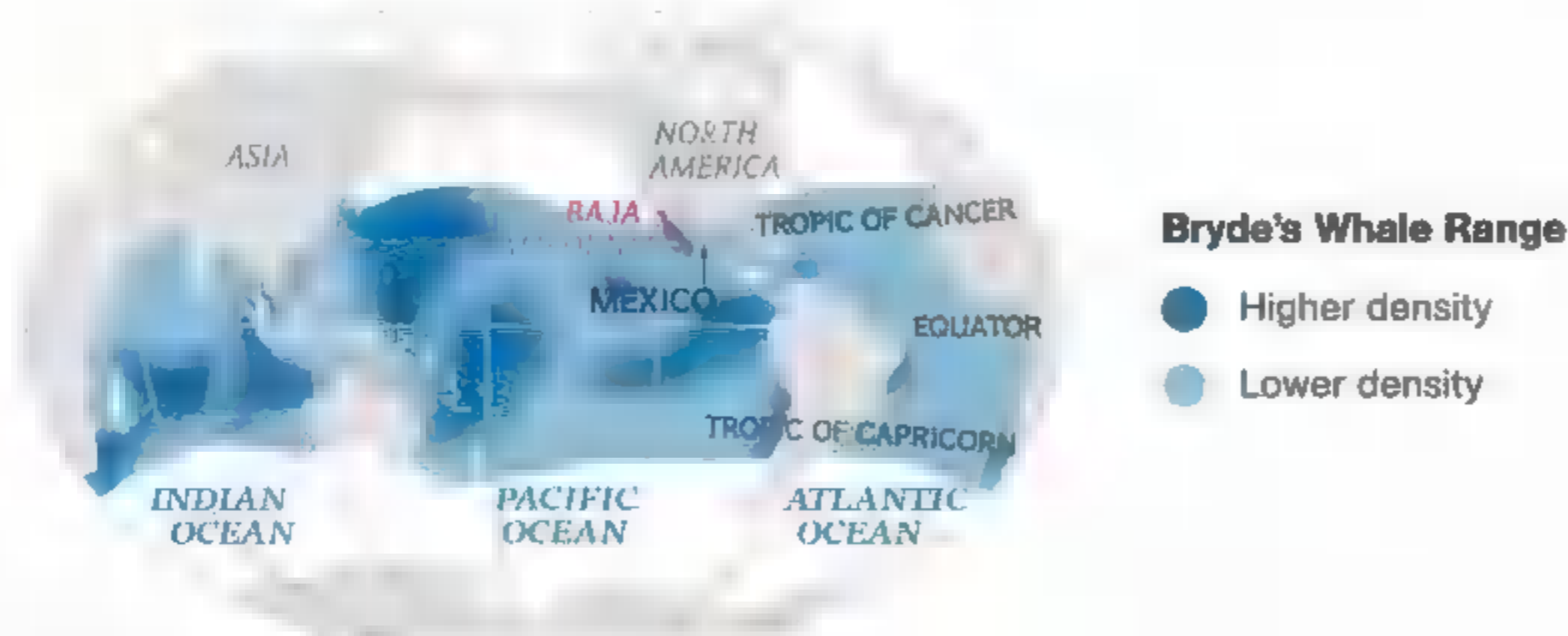
**T**he ocean off Baja erupts like a torpedo range. A long, lean whale shoots up from the deep, chasing thousands of mackerel and sardines as they're driven toward the surface by marlins and sea lions. Suddenly it lunges at the biggest mass of fish, mouth opening wide, throat pouch ballooning with seawater. Even against the tremendous drag created by its gaping maw, flicks of the whale's muscular tail power it through the water. Its jaw snaps shut in an explosion of bubbles. Other hunters circle nearby, waiting for a turn at the feast.

Named for a Norwegian whaling entrepreneur nearly a century ago, Bryde's (pronounced BROO-duhz) are baleen whales, which use meshlike mouth plates to filter food from the sea. "But they're hardly bloated, plankton-straining beasts puttering along at the surface," says photographer Doug Perrine. "They're sleek, predatory missiles," targeting larger, more mobile prey than some other baleen species. Perrine and colleagues were shooting marlins when they saw the rarely photographed whales. Diving with them "was like being on train tracks in the fog," Perrine says, "knowing a high-speed locomotive could appear in an instant," from any direction, without any warning sound.

Surprisingly little is known for sure about this species. Lacking thick layers of valuable blubber, Bryde's weren't much targeted by whalers. They've had scant attention from scientists, in part because they can be tough to find. Bryde's travel solo or in small pods and can dive to a thousand feet. Reported mostly in warm, equatorial waters, they probably breed year-round and may use low-frequency calls to find each other across great distances. But details of their movements, mating habits, and population status are sketchy, and sometimes inferred from better-known kin—making a wild encounter with Bryde's in the vast, blue ocean even sweeter. —Jennifer S. Holland

Built for bursts of speed that may top 18 miles an hour, Bryde's whales can grow 50 feet long and weigh 22 tons—smallish only compared with their colossal blue whale kin. An estimated 90,000 Bryde's live around the globe.

MARC MONTOCCHIO



CAITLIN SARGENT, NGM MAPS  
SOURCE: HIDEHIRO KATO, TOKYO UNIVERSITY OF MARINE SCIENCE AND TECHNOLOGY

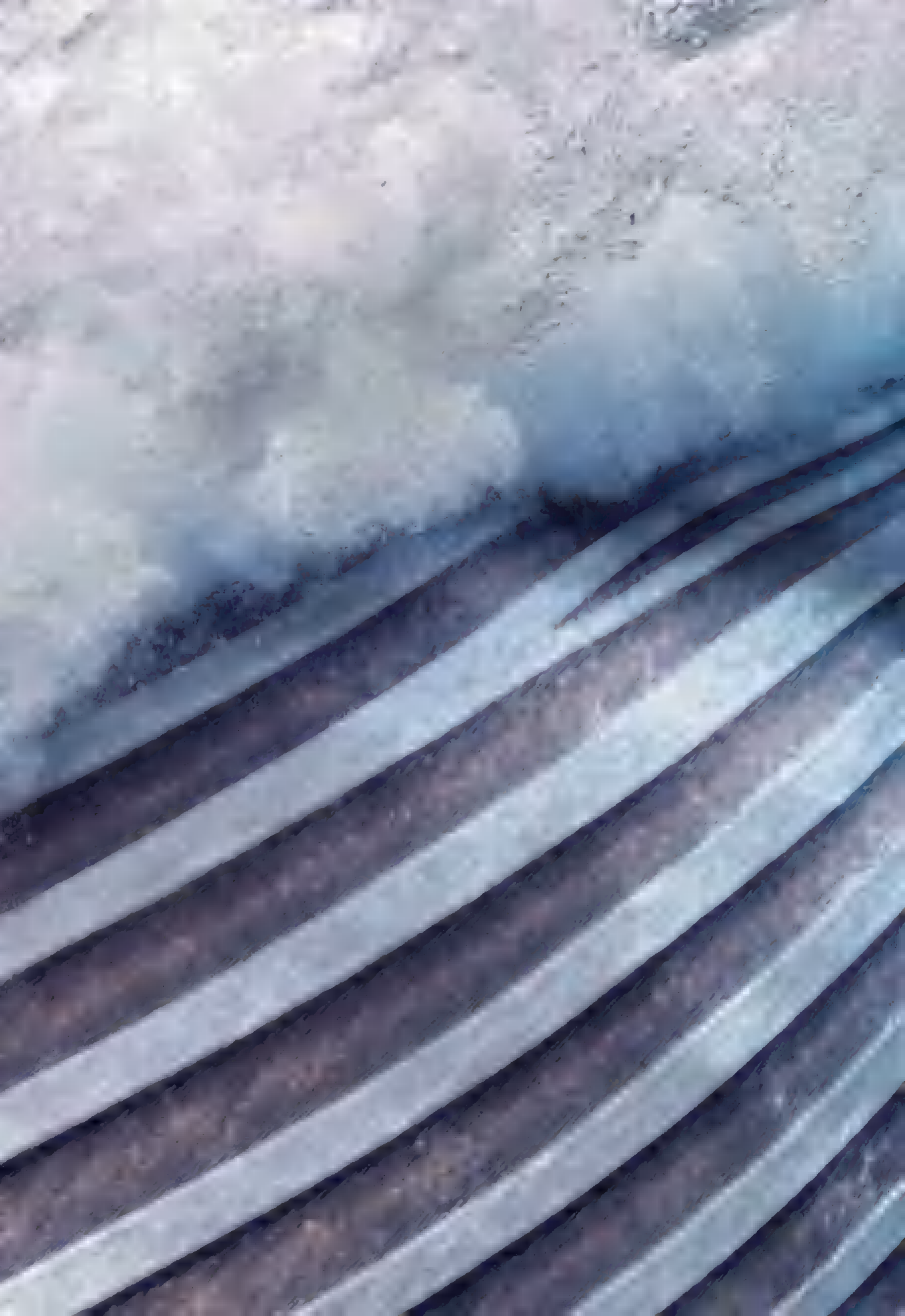




Open wide: A Bryde's  
upper jaw (far left)  
lined with baleen—  
hundreds of fringe-  
tipped plates of keratin,  
the stuff of other mam-  
mals' hair and claws.  
Baleen traps prey when  
the whale expels water.

DOUG PERRINE










Stretchy pleats of blubber and skin called throat grooves let a Bryde's underjaw pouch triple in volume as prey-filled seawater rushes in. Voracious eaters, Bryde's whales consume 1,300 pounds or more of food daily.

DOUG FERRINE



Sleek and maneuverable, Bryde's whale circles a swirling mass of fish as it prepares to seize a meal. Part collaborator, part competitor, the whale joins forces with marlins, sea lions, and other predators to hunt.

BRANDON COLE



INDONESIA

# Facing Down the Fanatics

A new paper trail is exposing religious extremism in the world's most populous Muslim country.



**TRADITION DICTATES** that girls be shrouded at Pesantren Sunanul Husna, a fundamentalist school in Jakarta.





**WOMEN WORK** at a West Sumatra gas station. Economic crises have persuaded many Indonesian families



not to rely only on men's earnings. More than half of all women have jobs, a number that grows each year.



**THE NATIONAL MOSQUE** in Jakarta can hold 120,000 souls for Friday prayers. Arab traders brought Islam to





the region a thousand years ago. Now 86 percent of Indonesia's 240 million citizens are Muslim, mostly Sunni.



**PILGRIMS** attired in special garments symbolizing purity and equality before God prepare to depart for Mecca.



Last year some 200,000 Indonesians made the hajj, more than from any other nation except Saudi Arabia.

BY MICHAEL FINKEL

PHOTOGRAPHS BY JAMES NACHTWEY



“Live respected or die as a martyr” reads the red-letter motto on the hoods of Front Pembela Islam members. Each year these self-appointed enforcers rally in Jakarta neighborhoods before and during the holy month of Ramadan, intimidating “purveyors of vice” such as bar owners and prostitutes. Last year their leader was jailed for inciting violence.



## HE ANSWERS THE DOOR HIMSELF.

No armed guards, no attempt to hide. Abu Bakar Baasyir lives in a modest one-story home on the campus of the boarding school he helped found in the quiet village of Ngruki, amid the central highlands of the main Indonesian island of Java. Baasyir is 71 years old, stalk thin, with a white goatee and lively dark eyes magnified by gold-rimmed glasses. He is the alleged spiritual leader of the militant Islamist group Jemaah Islamiyah, which has been linked to at least a half dozen bombings in Indonesia over the last decade, including the devastating 2002 Bali nightclub blasts and, perhaps, the suicide bombings at Jakarta luxury hotels this past summer.

Baasyir denies involvement in violence and, like a successful mafia don, has avoided a proven connection to any attacks. He served two stints in prison—a total of less than four years—on minor charges not directly related to the bombings. But the Islamic boarding school he established clearly was the hub for a network of jihadists set on creating an Islamic state in Southeast Asia; several of Ngruki's graduates have been convicted of involvement in major bombings. There's little question that Baasyir's teachings have been the inspiration for hundreds, perhaps thousands, of killings and for attacks against "deviant" Muslim groups that fall outside mainstream Islam. Still, he opens his own front door. "Come in," he says, speaking Bahasa Indonesia, the country's official language. "Have a glass of juice."

He is wearing a long, loose shirt, a white skullcap, and a large wristwatch. There are no chairs in his living room and no artwork, just clean white walls, a potted plant, and a low table supporting a plastic container of sesame cookies. He sits on the floor, barefoot, on a grass green rug. His adult son, Abdul Rahim, serves melon juice in tall, clear glasses.

"There is no violence in Islam," says Baasyir, in his deep, gravelly voice, waving his left hand

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*Michael Finkel reported on Bethlehem in the December 2007 issue. James Nachtwey is a five-time winner of the Overseas Press Club's Robert Capa Gold Medal.*

like a conductor. “But if there is hindrance by enemies, then we have the right to use violence in response. That’s what we call jihad. There is no nobler life than to die as a martyr for jihad.” He praises the September 11th and Bali bombings. They were not, he insists, acts of terrorism. They were simply “reactions to what has been done by the enemies of Islam.”

Indonesia is tucked away in a far corner of the world map, a rain of islands just north of Australia, yet violence here can have global repercussions. It is the most populous Muslim country in the world, home to 207 million Muslims—36 million more than the next largest Muslim nation, Pakistan, and two-thirds as many as all the countries of the Middle East combined. It is extremely devout; a recent Pew Global Attitudes survey found that Indonesia was one of the world’s most religious nations. It’s also a thriving democracy, the third largest

in the world, after India and the United States.

But it’s a new democracy, still finding its legs—little more than a decade has passed since the country’s virtual dictator, Suharto, was ousted. The end of his rule granted Indonesians new freedoms of expression, though it also unleashed radicals like Baasyir, who had honed his extremist views during a long exile in Malaysia, where he’d fled after his arrest for opposing Suharto. A year after the 2002 Bali bombings came the first J. W. Marriott hotel bombing in Jakarta, then in 2004 a strike on the Australian Embassy, also in Jakarta, and in 2005 a triple suicide attack, again in Bali. And just a few months ago, after a long gap during which many experts came to believe that the threat of terrorism was greatly reduced, came the bombings at the Ritz-Carlton Hotel and, once more, the J. W. Marriott. These are scattered events in a vast nation. But in the words of one Indonesian proverb, roughly translated,

In 2001 the government designated Aceh a Special Autonomous Region, allowing the province to implement sharia as part of its criminal code.



“It takes just a little poison to spoil all the milk.”

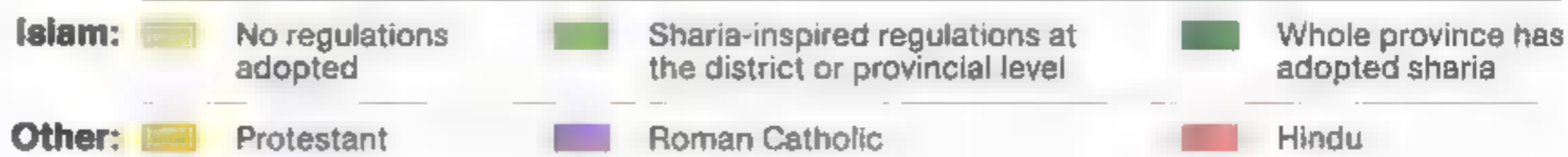
Indeed, Indonesia’s 17,500 islands can feel, at times, like so many marbles on a wobbly table. A subtle tilt, and they’ll all roll in one direction. As recently as 2005, Indonesia seemed to be tipping toward Islamic radicalism, feeding Western fears that it was becoming a haven for terrorists. For several decades, Indonesian society had been growing more overtly Islamic: Attendance at mosques swelled, and Muslim dress became popular. In the late 1990s, a growing number of district governments began enacting regulations inspired by sharia, or Islamic law, and support for Islamic political parties was on the rise. Increasingly, militant Islamic groups that advocated a violent struggle to recast Indonesia as an Islamic republic seemed to be drowning out the voices of the majority of Indonesian Muslims, who believe that their faith can smoothly coexist with modernity and democratic values.

But in the past few years, although Indonesians continue to embrace Islam in their private lives with greater fervor, it’s become clear that most don’t want religion to be enforced in the political sphere. “So many people equate Muslim piety with radicalism,” says Sidney Jones, an Indonesia specialist with the nonprofit International Crisis Group who has lived in the country for more than 30 years. “Indonesia is full of examples of why that notion is wrong.” As Islamist politicians have moved to regulate women’s dress codes and ban activities like yoga, moderates have begun to make their voices heard. In the Indonesian parliamentary elections this past April, candidates backed by Muslim organizations received less than 23 percent of the vote, down from 38 percent in 2004.

Though the recent bombings are a setback, Indonesia has lately been seen as a success story in how to curb violent extremism. Authorities

**MUSLIM REACH** Since 1998 many districts and some provinces have adopted regulations inspired by sharia—Islamic law. These range from banning alcohol and enforcing dress codes to compelling Islamic alms payments and requiring Koranic literacy. Critics say such rules subvert Indonesia’s constitution, which ensures religious freedom for all.

**Majority Religion by Province**



**86%** Percent Muslim by province, where available

\*Some districts in non-Muslim-majority provinces have also enacted regulations inspired by religious codes.



**The World’s Largest Muslim Populations**

2009 estimate, in millions

<b>Indonesia</b>	200
Pakistan	171
India	145
Bangladesh	138
Turkey	76
Egypt	75
Nigeria	75
Iran	65

PAPUA NEW GUINEA

AUSTRALIA

have arrested at least 200 members of Jemaah Islamiyah in the past five years, although some dangerous fugitives remain at large. Many radicals have shifted to advocating the establishment of Islamic law. Even Abu Bakar Baasyir, since his release from jail in 2006, has distanced himself from more militant factions of Jemaah Islamiyah and begun promoting the struggle for sharia as the way for Islamists to achieve their goal of transforming the democratic nation into an Islamic republic.

Baasyir believes that any human-created law-making body—a house of congress, a court of law—is an insult to the sovereignty of God. “Allah has sent a manual on how to treat human beings,” he says. “That manual is the Koran.” There’s no need, in his view, for any other code. “Islam and democracy,” he concludes, “cannot coexist.” Now that Suharto is out of power and centralized rule has been weakened, local districts

the way for Aceh to become the nation’s first province to establish sharia as criminal law.

Devi Faradila is a fashionable, 35-year-old mother of two and a parliamentarian in Aceh Province. At the time of my visit, she was the leader of the all-women’s unit of the Banda Aceh Sharia Patrol, a municipal force in charge of monitoring compliance with local rules in the province’s capital. On a typical Friday—a day, according to Aceh law, when all Muslim men must attend mosque—Faradila readied her unit for duty, breaking up a Ping-Pong game in the station house, wagging her finger at a couple of text messaging officers.

Faradila and 13 patrollers donned black baseball caps to complete their uniforms—black shoes, black slacks, black blouses, and lime green head scarves—and piled into a pickup equipped with loudspeakers. Faradila, in the driver’s seat, pulled on leather gloves, added a

## **INDONESIAN ISLAM MELTS WITH A MULTITUDE OF TRADITIONS. ONE GROUP EVEN DRINKS WINE IN ITS CELEBRATIONS, THOUGH THE KORAN WARNS AGAINST IT.**

can decide for themselves whether to institute sharia-based regulations. Where this has been done, Baasyir says, everything is better. Much better. “Go see for yourself,” he says.

**THE PROVINCE OF ACEH**, on the western prow of the Indonesian archipelago, is now perhaps best known for suffering a direct strike from the December 2004 tsunami, which killed more than 160,000 Indonesians. But for centuries, the Aceh region has been recognized as one of the most devout Muslim areas in all of Asia. Aceh’s unofficial slogan is that it is the “veranda of Mecca,” and many of its residents seem to sit on this porch with their backs to the rest of Indonesia, embracing an Islam closer to that which exists across the ocean on the Arabian Peninsula. Here, more than anywhere else in the islands, people observe a strict Islamic code of conduct. In 1999 the national government paved

fresh coat of lipstick, and put on mirrored sunglasses. Her deputy hopped in beside her. The rest of the women sat in the bed of the pickup.

The truck moved slowly through the city, Faradila blasting a constant stream of announcements over the speakers. “Hurry up, men! Friday prayers are about to begin.” “Stop all activities. It’s time to pray.” Men on the streets or in shops—a carpet seller, a furniture maker, a fruit vendor, a bricklayer—turned their heads and stared. A few checked their watches. “Today is Friday. It is obligatory for men to pray.”

Aceh is the only Indonesian province with a sharia patrol unit; a total of 800 officers, mostly men, police the region day and night. But at midday on Fridays, the Muslim Sabbath, sharia enforcement is left to the women, who can pray at home. Faradila wove the truck around the massive five-domed mosque at the city center, then toward the shoreline, which was both



Romaeni binti Hasan Basri (second from left) began wearing a chador during her last semester studying theater at the Jakarta Arts Institute. Her friends teased: "Are you growing a mustache?" But they got used to it. "Faith is a process," she says. "I'm going through the process, with or without the chador."



gorgeous, with mountains rising green from the sea, and haunting—giant swaths turned to swampland by the tsunami. One officer in back spotted a teenage girl strolling down a sidewalk with no head scarf, a reckless act in a city where virtually every Muslim woman is covered. The truck immediately screeched to a halt. "Veil! Veil! Veil!" the officers shouted. The girl looked aghast. She indicated in pantomime that she would put a covering on, and the truck drove off.

As prayer time grew near, Faradila's pleas became less polite. "Close your shop!" "Find the nearest mosque!" The truck pulled over in front of a dilapidated two-story building, a fish market and artists' studio, a known place for drinkers. The team leaped out of the truck—half Charlie's Angels, half Taliban. Two men were swiftly nabbed. They were fishsellers, they said, and smelled too bad to attend a crowded mosque.

The women issued them citations anyway.

A widely distributed booklet, *A Brief Look at Sharia Islam in Aceh*—the cover shows a man being whipped—outlines the rules. If you're caught gambling: six to 12 lashes. Improperly mingling with the opposite sex: three to nine lashes. Drinking alcohol: 40 lashes. Skipping prayer on three consecutive Fridays: three lashes. The whip, according to the booklet, must be made of rattan a quarter to a third of an inch thick. At the Banda Aceh Sharia Patrol station, two whips were on display, each as long as a cane and as snappy as a flyswatter. There was a photo album filled with images of the whippings; more than a hundred have taken place since 2005. The man who administers them wears a maroon robe, white gloves, and a face-covering hood. The crowds are enormous.

Polls indicate that, although most Indonesians say they want sharia as the foundation of



**MIRRORING THE PROPHET**, the men at one An-Nadzir commune in South Sulawesi shun technology, tie



their turbans and dye their hair as they think Muhammad did, and condemn all forms of violence.

A model vamps at a photo shoot for *ME Asia*, ■ magazine challenging Indonesia's moral conservatism. The 2006 arrival of a local, nudity-free edition of *Playboy* reignited national debate over censorship and decency. *Playboy* folded, and ■ new antipornography law passed, but some publishers are testing its bounds.



public life, they are uneasy about the imposition of such corporal punishments. Outside of Aceh, adoption of religious-based regulations has been piecemeal, with some districts prohibiting gambling or drinking, or requiring women to wear veils. Yet these rules have often been enacted by secular politicians who see Islamic regulations as a way to curry favor with their pious constituents or distract attention from ongoing corruption. In the future, experts say, playing the “Islam card” may not have the populist force it did just three or four years ago.

Except, perhaps, in Aceh, which appears to be ratcheting up its Islamization and has even considered implementing the surgical severing of hands in accordance with the Koran’s punishment for theft. That would be fine with Faradila. Sharia law, she insisted, has made Banda Aceh more reverent and much safer. She’d like to see an expansion of the laws. “Cutting hands,” she

said, “in the correct circumstances, would serve as a lesson to others. Crime would be greatly reduced.” Stoning for adulterers would also be fine. “When you embrace Islam,” she said, “you have to embrace all the laws.”

**FUNDAMENTALIST ISLAM** is a fairly recent import to Indonesia, where a relaxed if no less fervent form of the religion has long held sway. “Smiling Islam,” it’s often called. Islam originally came here the way most things come to islands—by sea. The islands’ volcanic soil is ideal for growing spices, and by the 12th century most of the traders taking Indonesian pepper and nutmeg and cloves to the West were Muslims from the Middle East. For Indonesian producers, converting to Islam had advantages—trading partners preferred fellow believers.

The spread of Islam into Indonesia was gradual and peaceful. What took one frenzied,

blood-soaked century in the Middle East required a leisurely half millennium in Indonesia. Scattered across some 3,000 miles of ocean, the islands had hundreds of ethnic groups and religious practices. Islam helped integrate previously separate peoples into a single regional culture. By the time the United East India Company, run by the Dutch, won control of the spice trade in the 17th century, Islam had spread to nearly all of Indonesia's coastal societies. "Islam was so successful coming to Indonesia because it was able to accommodate the existing culture and religions," says Syafi Anwar, executive director of the International Center for Islam and Pluralism in Jakarta. "Even in the architecture of the mosques, local style was incorporated."

Yet when the global reshuffle following World War II opened the path to independence from Dutch rule, Indonesia's first president, Sukarno, chose not to establish an official state religion.

away its regional flavor. That clash continues today, fueled in part by ideas and practices originating in the strict Wahhabism of Saudi Arabia, which has funded Islamic universities and boarding schools throughout Indonesia.

Still, across most of the country Islam continues to meld with a multitude of indigenous faiths and traditions. Rhythmic drumming, once associated strictly with native ceremonies, is often used before the Muslim prayer call, introducing the standard chant broadcast from mosque minarets. An Islamic group on Lombok Island even drinks a traditionally made palm wine in its celebrations, though the Koran warns against any alcohol consumption.

**PERHAPS THE QUINTESSENTIAL** expression of Smiling Islam can be found in Jakarta, Indonesia's messy, manic capital, where extravagant malls and cinemas with names like Hypermart

**"CUTTING HANDS," SAID FARADILA, "WOULD SERVE AS A LESSON TO OTHERS. CRIME WOULD BE GREATLY REDUCED." STONING FOR ADULTERERS WOULD ALSO BE FINE.**

Creating an Islamic republic, he felt, would alienate the minority of the population that was not Muslim; Sukarno himself had a mother of Balinese Hindu ancestry and a Muslim father. Indonesia's second president, Suharto, took power in 1966, in the wake of explosive anti-communist violence that killed half a million people, and for a while he was able to smother the hostilities and foster economic growth. But his regime was repressive and militarized. Suharto's resignation, in 1998, was triggered by a student-led, largely Muslim pro-democracy movement a few million strong—a development that some historians have cited as a landmark event in contemporary Islam.

But the end of Suharto's regime also intensified a schism within the Muslim community between those who supported the nation's traditional blending of Islam with local beliefs and those who sought to "purify" Islam, stripping

and Blitzmegaplex are under construction, and luxury high-rises abut teeming slums. Here, on a gravel side street, is the dusty, cluttered office of Ki Demit. *Ki* is the honorific bestowed upon Indonesian mystics. Ki Demit, whose name means Little Ghost, is 28 years old, baby-faced, and the son of another *ki*—Big Ghost—as well as the grandson and great-grandson of mystics. "I come from the most magical bloodline in Indonesia," he says.

In most places across the Middle East, such a statement would be heretical—anything paranormal not attributed to Allah is forbidden in Islam—but inscribed on a black batik in Ki Demit's waiting room is the menu of his charms. These include *santet* (sending a hex), *pelet* (gaining a lover), *kekebalan* (immunity from injury), and *kejantanan* (prowess in bed). One wall is covered with photos of celebrities—a soap opera star, a singer, a comedian—who



**A BLIND STUDENT** reads at Yayasan Raudlatul Makfufin, a school and foundation in South Jakarta that



distributes Braille Korans for free. Such Islamic charities form part of the safety net for less fortunate Indonesians.

have sought the help of Ki Demit or his father.

Ki Demit's clients sit cross-legged on the floor in front of him, a creaky ceiling fan above, the room crammed with candles and perfume bottles and prayer beads and antique knives. "I can read people's minds, and I can see the future," he says. "But I don't want to compete with God. I am only God's mediator." At the conclusion of many of his sessions, he'll give a client a handful of dried flowers he says are imbued with supernatural powers. Once the client takes a bath with the flowers, he says, his spell begins.

"I'm a good Muslim," insists Ki Demit. "Of course I pray five times a day. Of course I observe Ramadan. But long before Islam came to Indonesia, my ancestors were practicing these rituals. My father trained me as a ki, and when I have a son I will, of course, train him. I embrace Islam strongly, but I hold tightly to my powers. You cannot play with this power."

Her talk show, which featured movie stars, musicians, and athletes, set the conversational tone of Indonesia—her otherness, in a way, allowed her to openly express what might ordinarily be left unsaid. She chatted about marital troubles, spoke candidly of sex. ("Women, if you want to make love, don't wait for your man to offer. Go ahead and ask for it.")

In her dressing room after one show, she kicked off her shoes and greeted a stream of well-wishers. A 19-year-old boy told her, "I like your show because you are cute." A 90-year-old woman said, "I just want to kiss you." All the while, she rarely stopped talking, reminiscing about her early days in show business, when she served as the in-flight entertainment on chartered flights to Mecca. Only in Indonesia could a transsexual troubadour be deemed an appropriate diversion for hajj pilgrims.

"I'm a normal person," she said. "I behave as a

## **"THE MESSAGE WAS THAT IF I WANTED TO GO TO HEAVEN, I HAD TO JOIN THE SQUAD," SAYS ISMAIL. "IT'S SHOCKING THAT MORE OF US DIDN'T TURN TO EXTREMISM."**

**ACROSS TOWN** from Ki Demit is the television studio where singer and talk-show host Dorce Gamalama recorded her daily show (before it ended this past May). She's the Oprah of Indonesia, widely known by her nickname, Bunda, which means "mother." She taped her show in front of a studio audience of mostly middle-aged women in head scarves—conservative Muslims seem to be her biggest fans, perhaps because Dorce herself, beneath the buzzy energy and megawatt smiles, is a devout Muslim. Near her home in Jakarta, she's built her own mosque.

Oh, and one more thing: Dorce was born a male. She's a transsexual. She's had her "condition," as she calls it, all her life and had a sex-change operation in her 20s. She's been married twice, both times to men. She owns 300 pairs of shoes and a thousand wigs. She sings, dances, and tells mildly risqué jokes. She's not above taking the occasional comedic pratfall.

woman. I'm even prudish! There's no sex with me before marriage." When asked if her faith always comes before her career, she looked insulted. "My life," she told me, "is for God."

**THAT'S WHAT EVERYONE SAYS:** the militant, the mystic, the sharia cop, the TV star. United in their devotion to God, divided on how, precisely, one should express that devotion. The version of Islam that captures the minds of the next generation—the tolerant Smiling Islam or the austere and sometimes violent brand advocated by extremists—could determine the path Indonesia takes and perhaps provide a model for the future of global Islam. One place to gauge its direction is at the country's Islamic boarding schools, particularly the one located at the end of a bucolic lane in Ngruki, where Abu Bakar Baasyir teaches.

The school is actually a lovely place, buildings of white-painted brick capped by red- and



Before his execution in November 2008, Mukhlas, part of an al Qaeda-aligned group, remained gleefully defiant. In 2002 he helped plot bombings on Bali that killed 202 people. Other attacks followed, including blasts this past July. Police have arrested or killed scores of militants, including two of Mukhlas's brothers.



blue-tiled roofs. Outside the gate a man sells ginger milk from a bicycle-pulled cart. In front of the school's mosque, in the center of campus, an array of gum-ball-colored flip-flops are stuffed into wooden cubbies. Shouts echo across the basketball court. About 1,500 students, slightly more girls than boys, attend the school, which offers education at the junior and senior high school level. Students live in dorms, 20 to 30 per room, and sleep on mattresses on the floor.

Noor Huda Ismail is a former student at Ngruki, now 36 years old and an expert on security issues in Southeast Asia whom I hired to help set up interviews for this story. After the first Bali bombing, Ismail says, the Indonesian government sent an investigative team to Ngruki. The results were inconclusive. "There was nothing specific to terrorism in the curriculum," says Ismail. "The public face of Ngruki was like any other. There was nothing at

all clandestine—unless you were 'picked.'"

While at Ngruki, Ismail was, in fact, picked. "My indoctrination took place outside of class," he says. "It began with small meetings, teacher-student meetings during sports, during day hikes. I was told that our enemies are strong." He was an ideal candidate, he believes, due to his ability to speak English and Arabic.

"Just before I graduated," says Ismail, "I was invited to one of the teacher's houses. I sat on a mat on the floor. The light was low. There were three of us students there. The message was that Islam is your only possible salvation, and if I wanted to go to heaven, I had to join the squad. I was 15 years old." One of Ismail's roommates was Hutumo Pamungkas, who is now serving a life sentence for his participation in the Bali bombings. "It's shocking that more of us didn't turn to extremism," Ismail says.

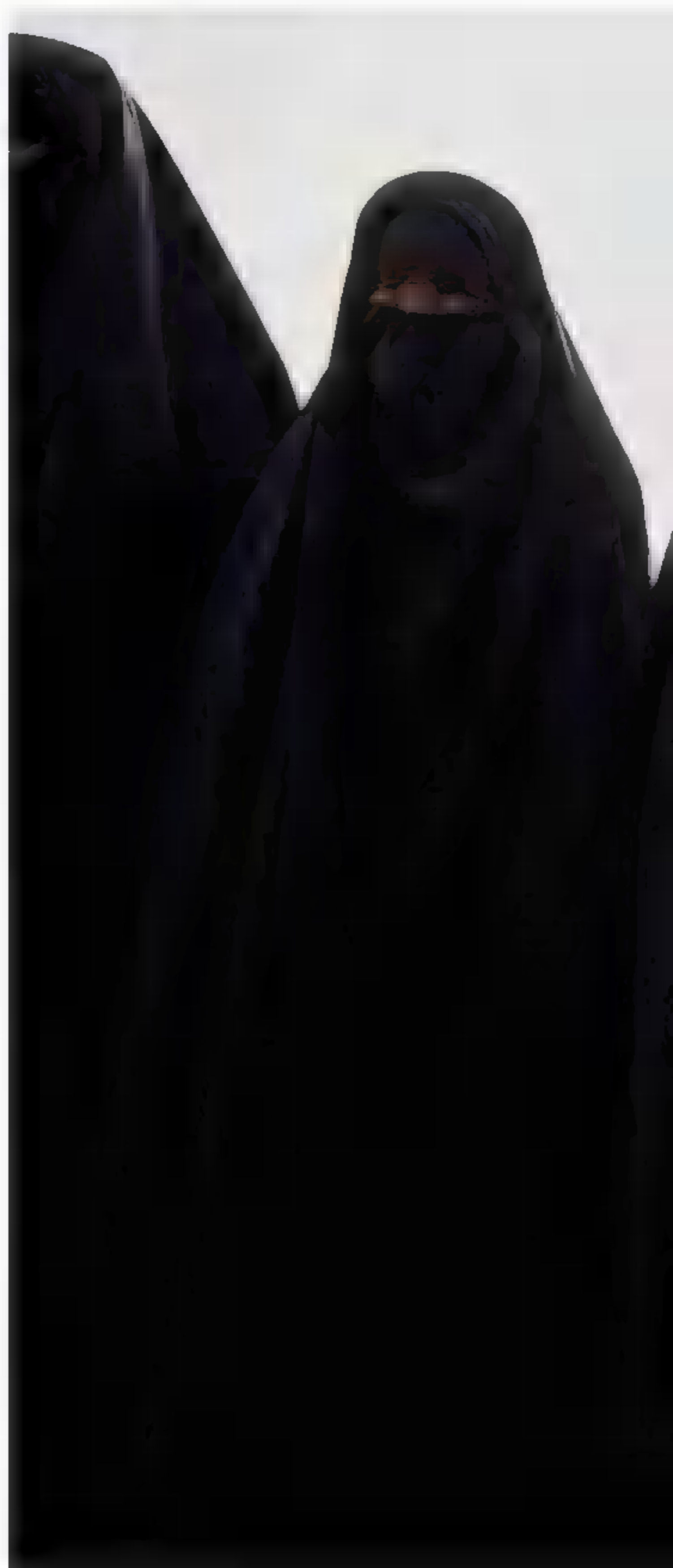
Robert W. Hefner, an anthropologist who

has studied Muslim politics in Indonesia, believes that Islamic extremism has lost much of its momentum in the archipelago, though it may be impossible to stop all attacks. Significant credit belongs to the Indonesian police, who have not only arrested hundreds of violent Islamists but have also successfully “deradicalized” some imprisoned militants by offering them conjugal visits and scholarships for their children. But the change is also the result of a decades-long effort by Islamic educators to implement reforms in their schools. Since 2004, all students entering the state Islamic system are required to take courses on civics, human rights, and democracy. Even Ngruki, despite its reputation as a hotbed of radicals, accepts the government’s guidelines.

Ultimately, Indonesia may be simply too big and diverse to adhere to any narrow definition of Islam. Even something as secular as one Indonesian takeoff on *American Idol* can be a platform for Islamic variety. During a recent season, the final two contestants were both Muslim women. One wore a veil, one did not. No one seemed to care. Indonesia’s national motto, after all, is “*Bhinneka tunggal ika*—Unity in diversity.”

“Islam in Indonesia is a huge tent under which all voices can talk to each other,” says Robin Bush, of the Asia Foundation. Fringe groups, she points out, can receive an inordinate share of media attention and frighten people away from publicly denouncing them. They can even send suicide bombers into hotels. But their reach has not extended into the ballot box.

Of course, that could change. Continued government corruption, another Suharto-like leader, a charismatic imam who can rally the disaffected—any of these might shift Indonesia’s balance. “If our secular government fails to deliver, Jemaah Islamiyah will have fodder to recruit,” says Ismail. “I think we are going to be constantly in flux,” he adds. “When the Western influences get too strong, the Islamist elements will get louder. When Islamist voices get too loud, the more secular voices will be raised. It will always be that way. Up and down. Up and down. Welcome to Indonesia.” □





Facing the dawn, women of the An-Nadzir commune begin Islam's Feast of the Sacrifice, which celebrates the Koran's account of God sparing the prophet Ismail. As the sun rises, their prayers join those raised by a chorus of Indonesia's Muslims, fundamentalist and moderate alike: "*Allah akbar.*" God is great.



In the heart of the Sahara, water from rains that fell millennia ago pools in the Waw an Namus volcanic crater. Winds carried black ash from the last eruption 12 miles out across the desert.

# Unseen

A RARE AERIAL LOOK AT LIBYA'S REMOTE FEZZAN REGION,



# Sahara

WHERE ANCIENT SOCIETIES THRIVED AND COLLAPSED AS THE RAINS CAME AND WENT

From left to right: the former sandstone pavilion  
of the Ming Dynasty (1368-1644) at Maridat. Long ago, it is  
green. However, tropical rains dissolved surrounding  
soil, helping create salty pools.







Date palms and reeds fed by an underground aquifer fringe the shore of Umm al-Maa, one of about a dozen salty pools in the Ubari Sand Sea—reminders of the ancient Lake Megafezzan.







Cut into rock at Wadi Matkandush 5,000 years ago, before the rains ceased and the Fezzan turned arid, sparring wildcats may have evoked the powers of fierce carnivores for humans who hunted here.



**An ancient wind** is coming up from a place called deep time. The Sahara strikes us as an eternal inferno of dunes and blue sky. We are dazzled by its vistas but fail to notice it as one of the great record-keeping places on Earth. The past survives here and speaks from the sand, rock, heat, and dry winds. It whispers to us about a history of repeated jolts of climate change and of the advance and retreat of humanity.

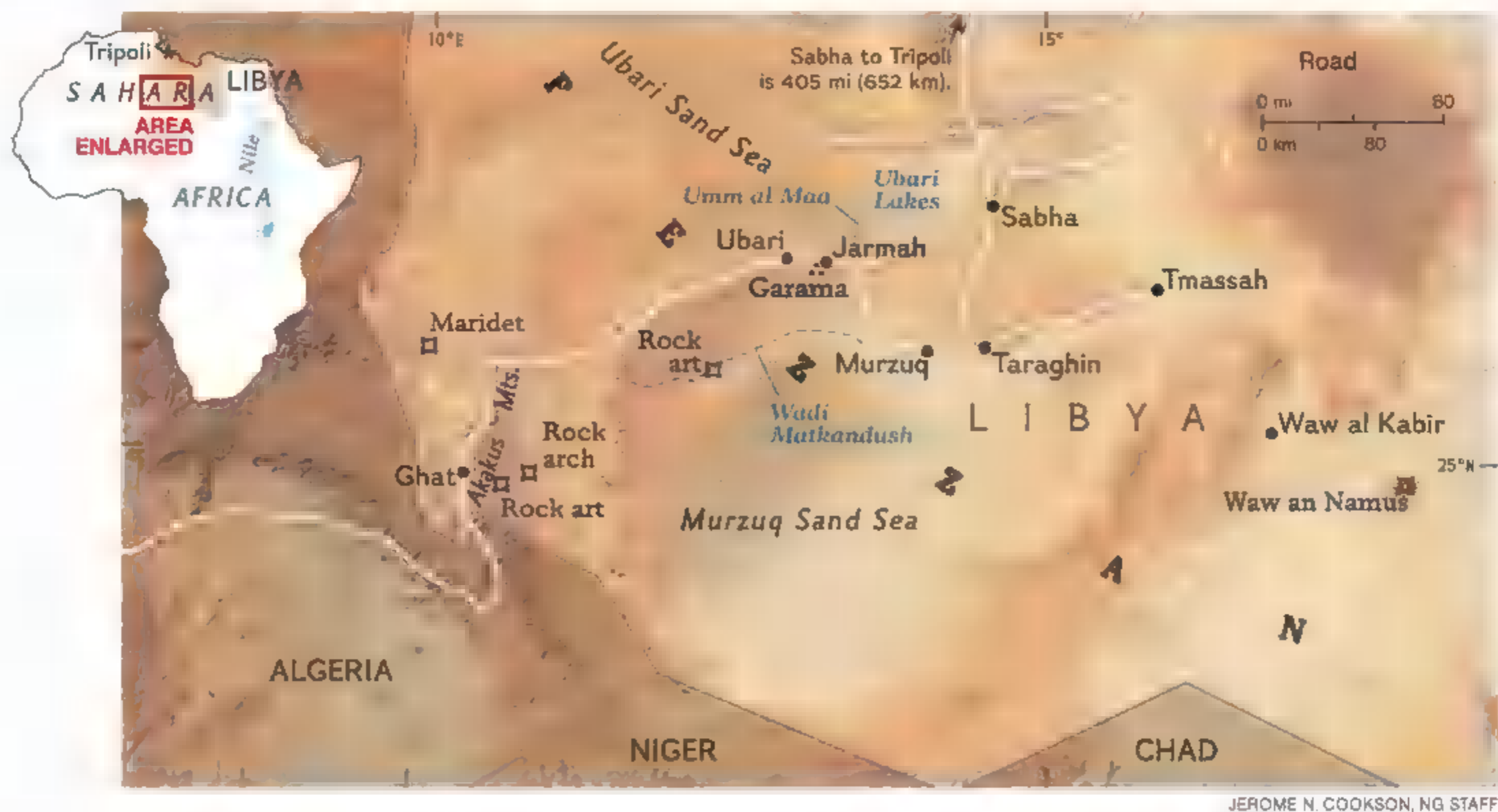
David Mattingly heads a team of scholars on the Desert Migrations Project, whose work takes us to prehistory. They are time travelers who use four-wheel-drive vehicles to navigate the Sahara looking for traces of our forebears. With special tires deflated to provide extra traction, they conquer dunes up to a hundred feet high. They have opened up a whole new way to see this desert.

In the southwest part of Libya, a region called Fezzan is the beating heart of the Sahara, an inaccessible place full of sand seas, wadis, mountains, plateaus, oases, and mystery. Between 500 B.C. and A.D. 500 an estimated 100,000 people farmed and thrived here, in an area that typically receives less than an inch of rain a year and many years none at all.

“That,” Mattingly notes, “is an awful lot of people in the hyperarid landscape of the central Sahara.”

An archaeologist at the University of Leicester, he’s become a slave to the desert: “I’ve been working in Libya for 30 years, and from the start I was wowed by the landscapes.” Many others have known this fate. They become addicted to brilliant light and uncluttered horizons. Where most see a wasteland, others find clarity.

Hugh Clapperton, a Scottish explorer, plunges into the desert of southwestern Libya between 1822 and 1825. He is the point man of an empire, the face of steam power, spinning jennies, and the British fleet. On November 7, 1824, he is crossing the dry ground when he comes upon a female slave left “to perish on the road today, her head was terribly swelled & unable to walk & insensible.” Clapperton finds one of the master’s servants huddled by the woman,



“waiting by her until she died, not to bury her but to bring away the few rags she had on.”

She cannot ride a camel; she is too weak to hold on. He thinks if he lingers, he will die too.

The wind is cold, he notes.

He rides on.

This is the Sahara of dread. A waterless sea of sand and stone, where scorpions infest, vipers slither, and the sun has no mercy. Libya is big—a slab of sun the size of Italy, France, Spain, and Germany—and almost all of its six million people live huddled on the Mediterranean coast. To truly understand the region, we must turn our backs on the sea and look south. Ninety-five percent of Libya is desert, 20 percent is dunes, and not a single perennial river runs through it. The Libyan Sahara holds the world’s heat record (136°F) and can chill the bones on a winter night.

Ibrahim al-Koni, Libya’s leading novelist, was raised as a Tuareg in the Fezzan. In his book *The Bleeding of the Stone*, he quotes a Sufi song:

*The desert is a true treasure  
for him who seeks refuge  
from men and the evil of men.  
In it is contentment,  
in it is death and all you seek.*

The Fezzan reveals thousands of years of life struggling against change, of humans adapting to a hostile environment. It is a time machine where the past slaps us in the face, and if we linger, things happen to our safe ideas.

We moderns have grudgingly accepted that the past is a record of shifts in climate, great migrations, the rise and fall of nations, yet we act as if our present is the final chapter. But in the Sahara a very long tale confronts any visitor, a reminder that this current chapter is thin and fragile.

Mattingly’s investigations bring him to the Ubari Sand Sea, where there are, improbably, many tiny, gem-colored lakes—some purple, some orange from minerals and algae—that are the dried-up reminders of a previous time when groundwater lay closer to the surface than it does today. It’s hard to imagine, but a lake the size of England, Lake Megafezzan, gleamed here about 200,000 years ago, when rainfall was abundant, and ancient channels testify that rivers ran in the center of the desert.

Climate change has been like an on-off switch in the Sahara. In dry times the lakes dwindled and the plants declined to niches. Then, when moister times returned, the lakes filled and parts



Traffic accidents are few, but billboards featuring Libyan ruler Muammar Qaddafi are everywhere in Fezzan's major city, Sabha, where less than half an inch of rain falls yearly. Beyond the city and a handful of towns lies the roadless Sahara.

of the Sahara were transformed to savanna. Human communities have pulsed here like the explosion of plants after a rare rain. When moist eras visited, they thrived. When the dry times returned, they shrank or collapsed.

How does one locate waterways of long ago? From way up high. Using radar images taken from space, Migrations Project team members Kevin White and Nick Drake have been able to map the location of mineral residues from ancient lakes and springs, then steer their Land Rovers to those spots, where paleoanthropologists Robert Foley and Marta Mirazón Lahr discovered stone tools, arrowheads, fireplaces, graves, and other clues to human occupation.

The earliest modern humans in the region were hunters and gatherers who lived in a savanna landscape about 130,000 years ago. Those people cleared out when the rains tapered off about 70,000 years ago, but then the rains returned and people moved in again. This back-and-forth migration is called the Saharan pump, a movement of people in and out of northern Africa as the climate shifted. Scratched on the desert's rocks are the memories of a wetter Sahara, when water-dependent creatures such as

lions, elephants, and rhinoceroses lived here.

A funny thing happened when the most recent wet phase ended. About 5,000 years ago the rains stopped once more, the lakes disappeared, and the desert took hold. Yet this time the people stayed. Rock art suggests they had already made the transition from hunting to raising livestock. Next came the rise of a society that would begin building towns and make the transition to agriculture: the Garamantian civilization.

The Garamantes flourished here in a climate much like that of the Sahara today. Many scholars assumed they were desert nomads, but excavations at their capital city, Garama (near modern-day Jarmah), and land surveys by Mattingly's team have shown they were sedentary people living off oasis agriculture. They constructed a sophisticated irrigation system that allowed them to grow wheat, barley, sorghum, date palms, and olives. Underground canals—called *foggaras*—tapped into

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*Charles Bowden is the author of Killing the Hidden Waters. George Steinmetz made the aerial pictures for this story from his motorized paraglider, which he assembled after his arrival in Libya.*



Carefully chosen light and dark stones mark the isolated grave of a herder who died between 5,000 and 3,000 years ago. As rainfall dwindled, Fezzan's inhabitants congregated around scattered oases.



groundwater and directed it to fields without loss to evaporation. Six hundred miles of these canals can still be detected. The system worked well for hundreds of years. And then the “fossil” water, stored up in wet times, started to give out, and the civilization collapsed.

The Sahara seems like a barrier at first glance, severing Africa into two pieces. But for the humans who have lived in Libya for thousands of years, it has been a corridor. Gold and ivory and slaves came north from sub-Saharan Africa; olive oil, wine, glass, and other goods from the Mediterranean flowed south. This trade creates a lasting image in our minds: the caravan winding its way through huge dunes.

The Saharan corridor may even have been one of the pathways our ancestors followed when they left the eastern part of the continent to populate the rest of the world. Scholars have long assumed that early humans expanded beyond sub-Saharan Africa into Eurasia by migrating either along the Nile River and across the Sinai or across the Red Sea. Now another notion is being explored: that the Fezzan may have been part of a long migratory corridor leading some modern humans to the shores of the Mediterranean and from there across the Sinai. Perhaps, through this sea of sand, our ancestors trekked from the Great Rift Valley and into our lives.

Mattingly says he likes archaeology because “it has lessons for today.” Fifteen hundred years after the fall of the Garamantes, the Libyan government is now building the Great Man-Made River, a series of huge aqueducts to mine ancient underground water reserves below the Sahara and use them to make the desert bloom. The water being pumped was deposited tens of thousands of years ago, in much wetter times. Already the water table is declining because of the pumping. The project has an estimated life span of only 50 to 100 years, a blink of the eye in this region.

Clearly the last chapter of the Fezzan is yet to be written. □

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**Society Grant** The photographer's expedition was funded in part by your National Geographic membership.

Pushed to and fro by alternating winds, undulating dunes in the Murzuq Sand Sea end up in much the same positions year after year. Medieval caravans navigated these crests to cross the Sahara.



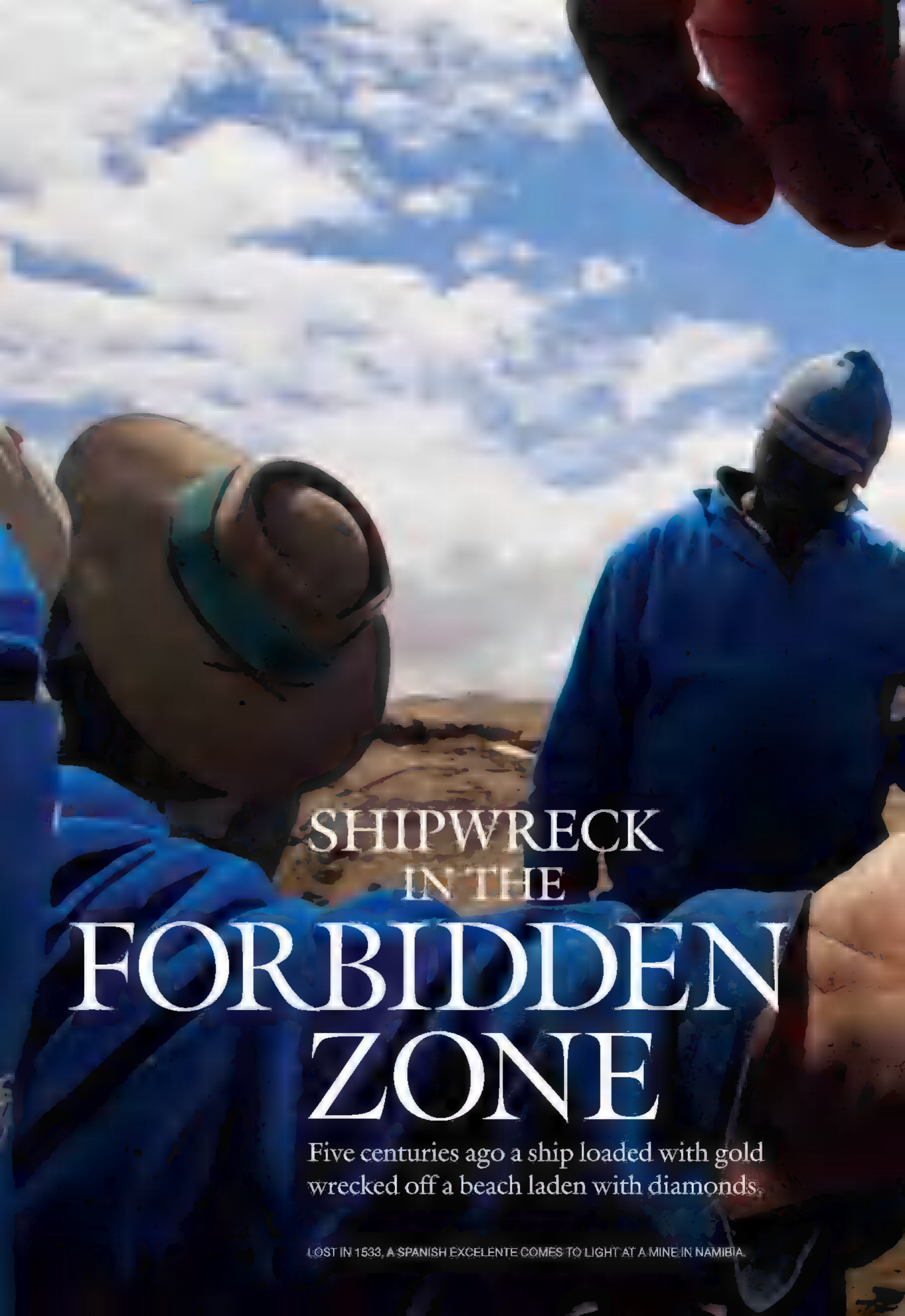






Sand powered strong winds carved an arch in the Akakus Mountains. A drying climate forced ancient people to retreat, leaving Fezzan's parched beauty quiet under desert skies.





SHIPWRECK  
IN THE

# FORBIDDEN ZONE

Five centuries ago a ship loaded with gold  
wrecked off a beach laden with diamonds.

LOST IN 1533, A SPANISH EXCELENTE COMES TO LIGHT AT A MINE IN NAMIBIA.





BY ROFF SMITH

PHOTOGRAPHS BY AMY TOENSING

ART BY JON FOSTER

**H**istory rarely unfolds like a fable. But consider this: A 16th-century Portuguese trading vessel, carrying a fortune in gold and ivory and bound for a famed spice port on the coast of India, is blown far off course by a fierce storm while trying to round the southern tip of Africa. Days later, battered and broken, the ship founders on a mysterious, fogbound coast sprinkled with more than a hundred million carats of diamonds, a cruel mockery of the sailors' dreams of riches. None of the castaways ever return home.

This improbable yarn would have been lost forever had it not been for the astonishing discovery in April 2008 of a shipwreck in the beach sands of the Sperrgebiet—the fabulously rich and famously off-limits De Beers diamond-mining lease near the mouth of the Orange River on Namibia's southern coast. A company geologist working in mining area U-60 came across what at first he took to be a perfectly round half sphere of rock. Curious, he picked it up and immediately





realized it was a copper ingot. A strange trident-shaped mark on its weathered surface turned out to be the hallmark of Anton Fugger, one of Renaissance Europe's wealthiest financiers. The ingot was the type traded for spices in the Indies in the first half of the 16th century.

Archaeologists would later find a staggering 22 tons of these ingots beneath the sand, as well as cannon and swords, ivory and astrolabes, muskets and chain mail—thousands of artifacts in all. And gold, of course, fistfuls of gold: more than 2,000 beautiful, heavy coins—mainly Spanish *excelentes* bearing the likenesses

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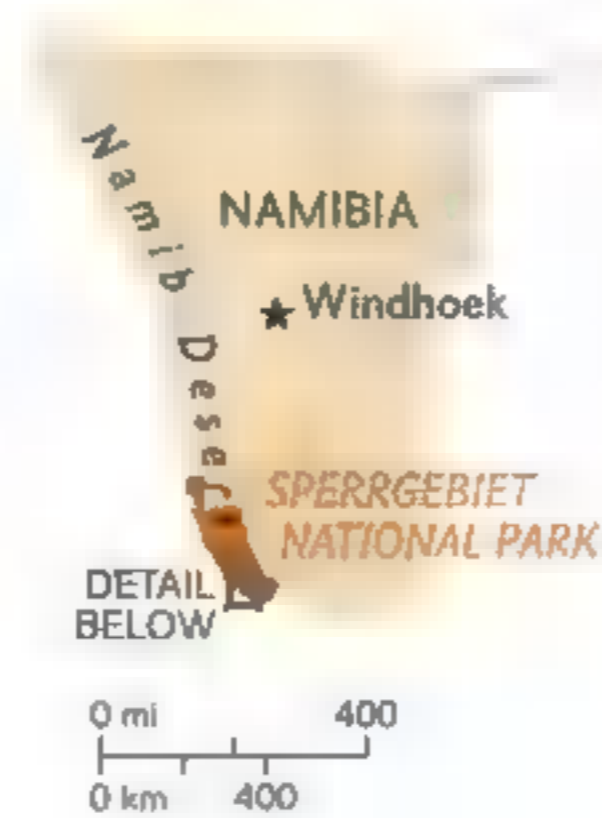
*Writer Roff Smith lives, and weathers storms, on the coast of England. Photographer Amy Toensing often covers remote outposts for National Geographic. Artist Jon Foster is best known for illustrating works of science fiction and fantasy.*

of Ferdinand and Isabella, but also a smattering of Venetian, Moorish, French, and other coinage, as well as exquisite portugueses with the coat of arms of King João III.

It is by far the oldest shipwreck ever found on the coast of sub-Saharan Africa, and the richest. Its dollar value is anyone's guess, but none of its treasures have fired the imaginations of the world's archaeologists as much as the wreck itself: a Portuguese East Indiaman from the 1530s, the heart of the age of discovery, with its cargo of treasure and trade goods intact, having lain untouched and unsuspected in these sands for nearly 500 years.

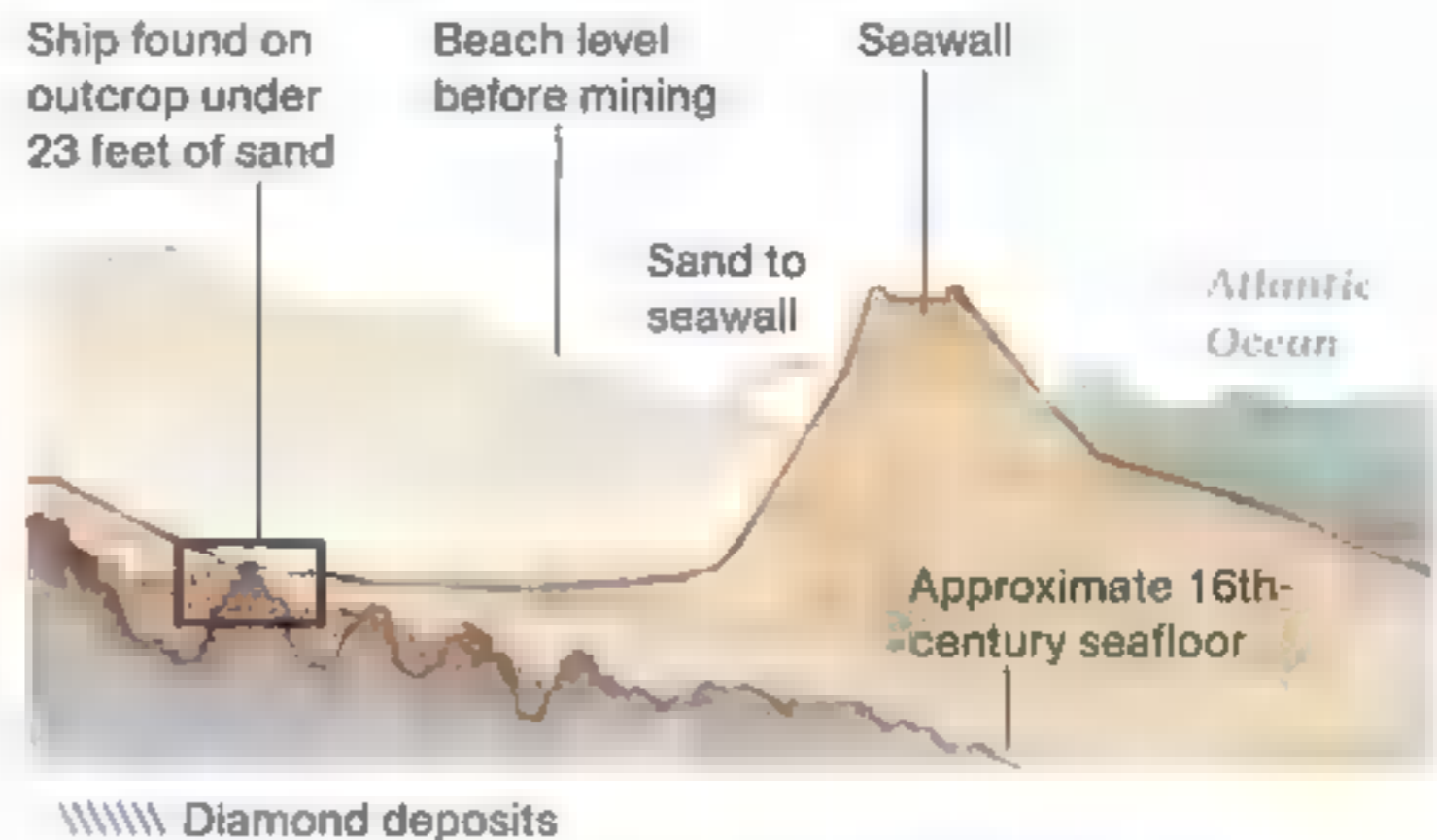
"This is a priceless opportunity," says Francisco Alves, the doyen of Portuguese maritime archaeologists and the head of nautical archaeology under the Ministry of Culture. "We know so little about these great old ships.





*Diamonds are the usual quarry along Namibia's southern coastline. Holding back Atlantic breakers, a 33-foot-tall seawall guards the huge surface-mining operation where the Portuguese wreck was discovered in April 2008. Mining at the site was halted, and archaeologists moved quickly to begin excavations.*

#### **Diamond Shipwreck site**



NGM MAPS. NG ART. SOURCE: NAMDEB DIAMOND CORPORATION. GRAPHIC NOT TO SCALE

This is only the second one ever excavated by archaeologists. All the others were plundered by treasure hunters.”

Treasure hunters are never going to be a problem here, not in the middle of one of the world's most jealously guarded diamond mines, on a coast whose very name—Sperrgebiet—means “forbidden zone” in German. Far from plundering, officials at De Beers and in the Namibian government, who work the lease as a joint venture called Namdeb, suspended their operations around the wreck site, called in a team of archaeologists, and for a few gloriously diverting weeks mined history instead of diamonds.

It will take scholars years to study the wealth of material gleaned from the Diamond Shipwreck, as it has come to be called. “So much is unknown,” says Filipe Vieira de Castro, the Portuguese-born coordinator of the nautical

archaeology program at Texas A&M University. Castro has spent more than ten years studying Portuguese trading vessels, or *naus*, lately developing computer models based on the slender archaeological pickings available. “This wreck will give us new insights into everything from hull design, rigging, and how these ships evolved, to little day-to-day things such as how they cooked meals on board and what people brought with them on these great journeys.”

Already, some inspired detective work among the rare manuscripts and royal archives in Lisbon has cobbled together enough bits and pieces to tell the tale of a long-forgotten voyage and a vanished ship that turned out to be as rich in irony and allegory as it was in gold.

The story begins on a fresh spring day in Lisbon—Friday, the seventh of March, 1533, to be exact—when the great *naus* of that year's India fleet sailed grandly down the Tagus River and out into the broad Atlantic, flags and pennants flying and colorful silks and velvets draped from their towering castles. These were the pride of Portugal, the space shuttles of their day, off on a 15-month odyssey to bring back a fortune in pepper and spices from distant continents. Goa, Cochin, Sofala, Mombasa, Zanzibar, Ternate: Storied places that once had been as remote as the stars were now familiar



ports of call, part of the Portuguese vernacular, thanks to Portuguese ingenuity and cutting-edge technology.

The outbound ships that sailed down the Tagus River in 1533 were sturdy and capable; two of them were brand-new and owned by the king himself. One of these was the *Bom Jesus*—the *Good Jesus*—captained by one Dom Francisco de Noronha and carrying 300 or so sailors, soldiers, merchants, priests, nobles, and slaves.

**PINNING A NAME** and a story to an anonymous, five-centuries-old shipwreck found unexpectedly on a far-flung shore takes canny sleuthing and more than a little luck—particularly if it is thought likely to have been an early Portuguese wreck. Although the Spanish Empire left mountains of paperwork in its wake, a catastrophic earthquake, tsunami, and fire in November 1755

virtually wiped Lisbon off the map and sent the Casa da India, the building that housed the vast majority of precious maps, charts, and shipping records, tumbling into the Tagus River.

“That left a huge hole in our history,” says Alexandre Monteiro, a maritime archaeologist and researcher who works with the Portuguese Ministry of Culture. “With no India archives left to peruse, one has to revert to other, more imaginative ways of finding information.”

In this instance, a vital clue came from the coins found in abundance on the wreck—particularly those beautiful and rare portugueses of King João III. These were minted for only a few years, from 1525 to 1538, after which they were recalled, melted down, and never reissued. Finding so many sparkling new portugueses on the wreck is a strong indication that the ship sailed during this 13-year window in time.



*Under constant surveillance, miners and archaeologists salvaged the remains of the ship and its cargo of riches. Hoses vacuumed the diamond-laced sands around the wreck, which was excavated in just ten weeks.*

Moreover, the load of copper ingots suggests the ship was on its outward passage to India to buy spices rather than returning.

Although the complete Casa da India records are long gone, some tantalizing snippets remain in libraries and archives that survived the 1755 earthquake. Among these are the *Relações das Armadas*, the so-called narratives of the fleets. A thorough study of the most complete narratives shows that 21 ships were lost on the way to India between 1525 and 1600. Only one of these went down anywhere near Namibia: the *Bom Jesus*, which sailed in 1533 and was “lost on the turn of the Cape of Good Hope.”

Another intriguing pointer to the *Bom Jesus* comes from a letter Monteiro unearthed in the royal archives. Dated February 13, 1533, it reveals that King João had just sent a knight to Seville to pick up 20,000 crusadoes’ worth of

gold from a consortium of businessmen who had invested in the fleet that was about to sail for India—the fleet that included the *Bom Jesus*. Archaeologists had been puzzled by the huge quantity of Spanish coins found among the wreckage—about 70 percent of the gold pieces were excelentes, unexpected for a Portuguese ship. “This letter would go a long way toward explaining that,” says Monteiro. “Spanish investors, it seems, had an unusually large stake in the 1533 fleet.”

A rare 16th-century tome called the *Memória das Armadas* even offers a tantalizing glimpse of the *Bom Jesus*. Issued as a commemorative volume, a sort of Renaissance-era coffee-table book, it contains illustrations of all the fleets that sailed for India each year after Vasco da Gama pioneered the route in 1497. Among the pictures for 1533 is a vignette of two rigged masts under full sail disappearing into the waves and the words “*Bom Jesus*” together with a simple epitaph: *perdido*—lost.

So what did happen? It seems that four months or so after its grand departure from Lisbon, the first fleet of 1533 was struck and scattered by a huge storm. Details are sketchy. An account of the voyage by Captain Dom João Pereira, the fleet’s commander, has been lost. All that remains is a clerk’s acknowledgement that the report was received and a mention that the *Bom Jesus* disappeared in wild weather somewhere off the cape. It is easy to envision what might have happened next: The storm-battered ship was caught up in the powerful winds and currents that surge along the southwest African coast and was driven helplessly northward for hundreds of miles. As the windswept scrub of the Namib Desert hove into view, the doomed nau struck an outcrop of rock about 150 yards from shore. The shuddering blow broke off a big chunk of the stern, spilling tons of copper ingots into the sea and sending the *Bom Jesus* to its grave.

**FAST-FORWARD** five centuries to a maritime archaeology site that feels slightly surreal. A knot of researchers in hats and sunscreen are excavating a sunken ship that rests some 20 feet below sea level, the Atlantic Ocean held back by a massive earthen retaining wall that leaks a bit along its base. Closed-circuit television cameras, set up around the perimeter of the site, monitor

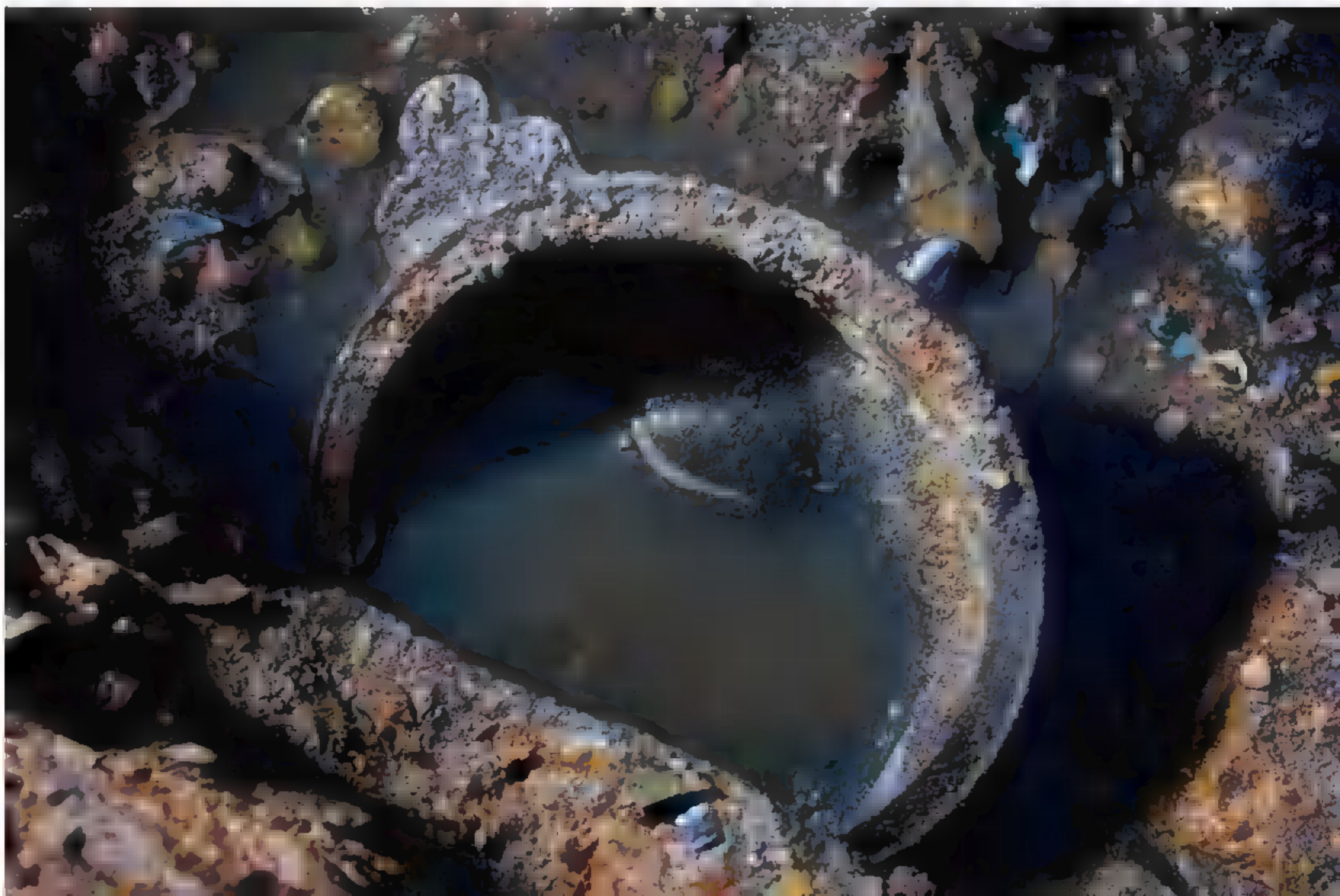


*Mariners' astrolabes (above) helped explorers calculate latitude by measuring the angle of the sun and familiar stars above the horizon—when skies were clear enough for sightings. A five-inch-long syringe (below) would have been used to administer doses of mercury to travelers plagued by syphilis, epidemic in 16th-century Europe.*





*Money for buying India's precious spices, Spanish and Portuguese coins mingled with Venetian, Florentine, and Moorish (above) in the ship's coffers. The wreck yielded nearly 50 pounds of gold coins. Poignantly simple, a pewter porringer (below) likely served as an everyday eating vessel for one of the ill-fated voyagers.*



everyone's movements—a reminder that for all the excitement of the find, this is still a diamond mine. And a rich one, where loose diamonds could well be mingled in the sands the archaeologists are brushing away.

“If it hadn't been for those copper ingots weighing everything down, there would be nothing left here to find,” says Bruno Werz, director of the Southern African Institute of Maritime Archaeology, who was called in from Cape Town to assist with the excavation. “Five centuries of storms and waves would have washed everything away.”

Werz and a team of researchers have been poring over the wreckage, measuring, photographing, scanning the site millimeter by millimeter with a state-of-the-art, three-dimensional laser scanner. They are trying, among other things, to piece together the ship's final harrowing moments, which would not have been pretty—the mangled remains of the hull and forecastle and a tangle of sails, spars, and rigging sloshing about in the swell, drifting north with the current and probably breaking apart as it went. Mine workers found a huge wooden rigging block three miles farther up the coast.

And what of the people on board, Dom Francisco and the rest?

“A winter storm along this coast is no joke,” says Dieter Noli, the mine's resident archaeologist, who has lived and worked along this stretch of the Namib Desert for more than ten years. “It would have been nasty, with winds of over 80 miles an hour and a huge breaking surf. Getting ashore would have been just about impossible. On the other hand, if the storm had blown itself out and the ship wallowed ashore on one of those quiet, fog-shrouded days we also get around here, well, now that opens up all kinds of interesting possibilities.”

That may have happened. Although the discovery of human toe bones in a shoe found pinned beneath a mass of timbers indicates that at least one person did not survive, those were the only human remains recovered from the wreck. And few personal possessions were found among the artifacts. These facts lead archaeologists to believe that despite the break-up of the ship along the surf line, many if not most of those aboard made it to land.

And then what? This is one of the most inhospitable places on Earth, an uninhabited



*Archaeologist Bruno Werz waits to guide a piece of wooden rigging into a freshwater preservation tank. Such rare treasures promise remarkable new perspectives on Portugal's golden age.*

wasteland of sand and scrub stretching for hundreds of miles. It was winter. They were cold and wet, exhausted and bereft. There was no hope of rescue or a search party, for nobody in the outside world knew they were alive, let alone where to start looking. Nor was any ship likely to pass this way by chance; they were far off the trade routes. As for somehow getting back to Portugal—well, the crew might as well have been shipwrecked on Mars.

All the same, things needn't necessarily have ended badly for the castaways, according to Noli. The Orange River lay only 16 miles to the south of the wreck, a source of fresh water whose bloom they might have noticed as they drifted by its mouth. And there was plenty of food about: shellfish, seabird eggs, and loads of desert land snails.

What's more, the Portuguese could have met



the local survival experts. Winter was the season when hunter-gatherers known today as Bushmen ventured north along this shore in hopes of finding the carcasses of the southern right whales that occasionally wash ashore here.

How the Portuguese fared in these encounters would have been up to them, says Noli. “If they had the wit to trade rather than try to take, there is no reason to believe everybody wouldn’t get along. The few small bands of hunter-gatherers along the river had no population-resource pressures to contend with, and so no reason to be aggressive to the newcomers. On the contrary, a big, strapping Portuguese dom could well have been seen as an attractive prospect for a son-in-law.”

Whatever their final fate, the survivors of the *Bom Jesus* had no inkling of the exquisite irony with which their prayers, uttered so long ago in Lisbon, had been answered. They’d set off on ■

great journey in search of riches, pledging altars and icons for favor and success. Now here they were, delivered onto a shore of unimaginable wealth—a 185-mile stretch of desert so fantastically rich in high-quality diamonds that in the early 1900s an explorer named Ernst Reuning made ■ wager with a companion about the amount of time it would take to fill a tin cup with gems found loose in the sand. The job took all of ten minutes.

For long ages the great river had been washing millions, even billions of diamonds down from deposits as far as 1,700 miles inland. Only the hardest, most brilliant, gem-quality stones, some weighing hundreds of carats, survived the journey. They spilled into the Atlantic at the river’s mouth and were washed up the coast, borne by the same cold current that would one day sweep the *Bom Jesus* to its death. □



Sporting helmets since branches can break and fall, an expert crew (top) helps Nick Nichols and Ken Geiger (above) solve ■ redwood photo riddle.

**ON ASSIGNMENT Team Redwood** “The world is going to wonder how we got that picture,” says Nick Nichols about the foldout photograph in this month’s issue (a two-by-six-foot fine art print is now available for purchase at [PrintsNGS.com](http://PrintsNGS.com)). “It was a total team effort.” After a year of talks and planning, photographer Nichols, *National Geographic* Senior Editor Ken Geiger, and several additional team members figured out how to shoot the massive, 1,500-year-old redwood: They tethered a rope between two trees and from it hung ■ pulley system carrying three cameras. As the cameras descended, Nichols—on the ground nearby—shot pictures remotely from ■ laptop computer. It took three weeks of predawn attempts, but finally, in one morning, they captured the 84 images that make up the foldout. After the shoot Geiger spent more than 120 hours digitally stitching them together to create what Nichols now lovingly calls “the collaborative composite.”

## Society Updates



### NG EXHIBITIONS

Tickets are on sale now for “Terra Cotta Warriors: Guardians of China’s First Emperor.” Performance artist Cheng Chi Chang (above) toured Washington, D.C., this spring touting the exhibit, which opens on November 19, 2009, and runs until March 31, 2010, at the National Geographic Museum. Visit [warriorsdc.org](http://warriorsdc.org) for exhibition details.

### NG CHANNEL

What secrets lie in the past—and future—of the world’s tallest trees? National Geographic Explorer-in-Residence Mike Fay and Humboldt State University’s Steve Sillett find out in *Climbing Redwood Giants*, airing September 29 at 10 p.m. on the National Geographic Channel.

### NG FILMS

Former NG All Roads grant recipient Cherien Dabis’s *Amreeka* is the humorous but tender tale of a Palestinian mother’s immigration to the United States. *Amreeka*, ■ National Geographic Entertainment film, is in theaters now.

### GeoPuzzle Answers

I	O	N	A	W	E	B	C	A	M	D	O	G	E			
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Be the change you want to see in the world.

—MAHATMA GANDHI

## FRAGILE: The Human Condition

PHOTOGRAPHS AND TEXT BY HOWARD G. BUFFETT

FOREWORD BY SHAKIRA MEBARAK



Billions of people across this planet live lives of poverty and desperation. They did not choose their circumstances nor can they change them. Their plight is difficult to confront, but impossible to ignore.

The poignant images and personal stories in this book allow us to meet these people, whose resilience and spirit, though fragile, remains uncrushed. Many cling to the hope that their lives will change, and our hope is that this moving portrait will inspire others to find solutions...to be the change.

For more information and to order copies, visit [nationalgeographic.com/books](http://nationalgeographic.com/books)



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320 PAGES • 436 COLOR PHOTOGRAPHS • \$35.00

# Amish mantle and miracle invention help home heat bills hit rock bottom

*Miracle heaters being given away free with orders for real Amish fireplace mantles to announce the invention that helps slash heat bills, but Amish craftsmen under strain of early Christmas rush force household limit of 2*

**Save money: only uses about 9¢ electric an hour; so turn down your thermostat and never be cold again**

By MARK WOODS  
Universal Media Syndicate

(UMS) Everyone hates high heat bills. But we're all sick and tired of simply turning down the thermostat and then being cold.

Well now, the popular HEAT SURGE® miracle heaters are actually being given away free to the general public for the next 7 days starting at precisely 8:00 a.m. today.

The only thing readers have to do is call the National Distribution Hotline before the 7-day deadline with their order for the handmade Amish Fireplace Mantle. Everyone who does is instantly being awarded the miracle heater absolutely free.

This is all happening to announce the HEAT SURGE Roll-n-Glow® Fireplace which actually rolls from room-to-room so you can turn down your thermostat and take the heat with you anywhere. That way, everyone who gets them first can immediately start saving on their heat bills.

Just in time for winter weather, portable Amish encased fireplaces are being delivered directly to the doors of all those who beat the deadline.

These remarkable fireplaces are being called a miracle because they have what's being called the *Fireless Flame*™ patented technology that gives you the peaceful flicker of a real fire but without any flames, fumes, smells, ashes or mess. Everyone is getting them because they require



■ **GENUINE AMISH MANTLES MADE IN THE USA:** Everyone wants to save money on heat bills this winter, so entire Amish communities are working from the crack of dawn to finish. These fine real wood Amish made fireplace mantles are built to last forever. The oak mantle is a real steal at just two hundred ninety-eight dollars because all those who beat the order deadline by calling the National Hotline at 1-866-815-7004 to order the fireplace mantles are actually getting the imported hi-tech *Fireless Flame* HEAT SURGE miracle heaters for free.

no chimney and no vent. You just plug them in.

The *Fireless Flame* looks so real it amazes everybody because it has no real fire. So what's the catch? Well, soft spoken Amish craftsmen who take their time hand building the mantles



■ **JUST ANNOUNCED:** The Heat Surge miracle fireplace has earned the prestigious Good Housekeeping Seal. The product has earned the Seal after evaluation by the Good Housekeeping Research Institute.

have a process that forces ■ strict household limit of 2 to keep up with orders.

"We can barely keep up ever since we started giving heaters away free. With winter just around the corner, everyone's trying to get them. Amish craftsmen are working their fingers to the bone to be sure everyone gets their delivery in time for Christmas," confirms Frederick Miller, National Shipping Director.

"These portable Roll-n-Glow Fireplaces are the latest home decorating sensation. They actually give you ■ beautifully re-decorated room while they quickly heat from wall to wall. It's the best way to dress up every room, stay really warm and slash your heat bills all at the same

time," says Josette Holland, Home Makeover Expert.

And here's the best part. Readers who beat the 7-day order deadline are getting their imported hi-tech miracle heaters free when encased in the Amish built real wood fireplace mantles. The mantles are being handmade in the USA right in the heart of Amish country where they are beautifully hand-rubbed, stained and varnished.

You just can't find custom made Amish mantles like this in the national chain stores. That makes the oak mantle a real steal for just two hundred ninety-eight dollars since the entire cost of the miracle heater is free.

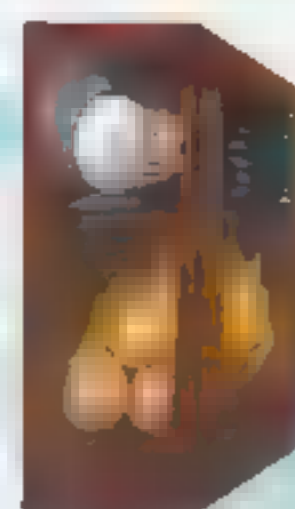
This free giveaway is the best way to slash heating bills and stay warm this

# HEAT SURGE™ Fireless Flame™

**How It Works:** The HEAT SURGE miracle heater is a work of engineering genius from the China coast so advanced, you simply plug it into any standard outlet. It uses only about 9¢ of electric an hour on the standard setting. Yet, it produces up to an amazing 5,119 BTU's on the high setting. So watch out, a powerful on board hi-tech heat turbine silently forces hot air out into the room from the vent so you feel the bone soothing heat instantly. It even has certification of Underwriters Laboratories coveted UL listing. It also comes with a limited full year replacement or money back warranty less shipping plus a 30-Day Satisfaction Guarantee. OH and FL resident transactions require the remittance of applicable sales tax. Sorry no shipments to MA residents.



LISTED: E322174



Hot air only comes out of the top vent

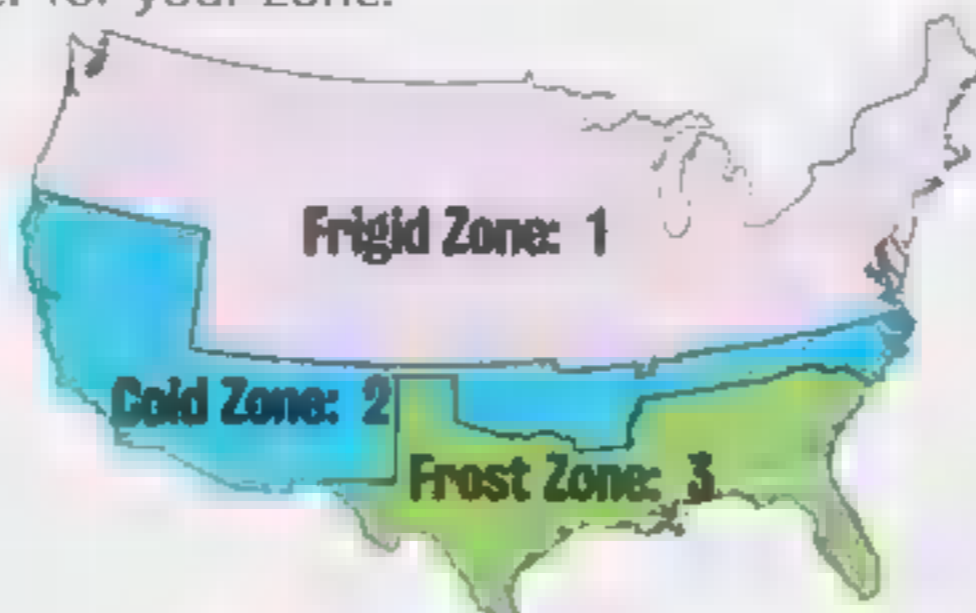
The hi-tech silent heat turbine takes in cold air

## How to get 2 free heaters

The National Toll Free Hotlines are now open. All those who beat the 7-day order deadline to cover the cost of the Amish made Fireplace Mantle and shipping get the HEAT SURGE miracle heater free.

A strict limit of 2 per household has been imposed. Since some home woodworkers want to build their own mantle piece, they are letting people get the imported miracle heater alone for just \$249. Or, with the Amish made mantle you get the miracle heater free.

Use the map below to locate the weather zone you live in and call the Hotline number for your zone.



Claim Code: FP9167

EVERYONE LIVING IN THE  
**Frigid Zone: 1**  
START CALLING AT  
8:00 A.M. TODAY  
1-866-815-7004

EVERYONE LIVING IN THE  
**Cold Zone: 2**  
START CALLING AT  
8:30 A.M. TODAY  
1-866-815-7110

EVERYONE LIVING IN THE  
**Frost Zone: 3**  
START CALLING AT  
9:00 A.M. TODAY  
1-866-815-7112



■ **ON THEIR WAY:** Early Christmas orders have turned country roads into pipelines to the big city delivery system. Everybody wants a fireplace that comes fully assembled with a handmade Amish mantle in oak or cherry finish and gets delivered by truck right to your door. All you do is plug it in.

fall and winter. The HEAT SURGE Roll-n-Glow Fireplace gives you zone heating and all the beauty and warmth of a built-in fireplace but rolls from room-to-room so it can also save you a ton of money on heating bills.

Even people in California and Florida are flocking to get them so they may never have to turn on their furnace all winter. And since it uses only about 9 cents of electric

an hour on the standard setting, the potential savings are absolutely incredible.

"We are making sure no one gets left out, but you better hurry because entire communities of Amish craftsmen are straining to keep up with demands. For now, we are staying out of the large national retail stores in order to let readers have two per household just as long as they call before the

deadline," confirms Miller.

It's a really smart decision to get two right now because for only the next 7 days you get both miracle heaters free. That's like putting five hundred bucks right in your pocket and you can save even more money on your monthly heating bills.

"Everyone's calling to get one but those who are getting their Christmas shopping done early are surprising the whole family by

getting two. So when lines are busy keep trying or log onto [amishfireplaces.com](http://amishfireplaces.com). We promise to get to every call. Then we can have a delivery truck out to your door right away with your beautiful Heat Surge Roll-n-Glow Fireplace," Miller said.

"You'll instantly feel bone soothing heat in any room. You will never have to be cold again," he said. ■

On the worldwide web:  
[www.amishfireplaces.com](http://www.amishfireplaces.com)

### Rolls anywhere to throw an instant heat wave with no chimney, no vents, no wood and no smoke



■ **EASILY ROLLS ANYWHERE:** This is the portable Roll-n-Glow® Fireplace that easily rolls from bedroom to living room to keep you warm. No vents, no chimney and no tools. Just plug it in.



■ **SAVES ON BILLS:** Everyone can get low bills and stay warm and cozy. The Roll-n-Glow Fireplace saves a ton of money and makes your front room look like a million bucks.



■ **SAFE FLAME:** The Fireless Flame looks so real it fools everyone but there is no real fire. That makes the flame window safe to the touch under the watchful eye of a parent. It's where the kids will play and the cat and dog will sleep.



■ **FREE:** Get this \$249 miracle heater free. It is being given away free to all who beat the 7-day order deadline for your choice of the oak or cherry finish Amish Mantles. The free heater comes already encased.



**Bali Dancer** A towering headdress and plug earrings adorn ■ 1930s Balinese *djanger* dancer, part of a coed performance that was “more of popular fun than of temple dance or disciplined art,” wrote Maynard Owen Williams in his March 1939 *Geographic* article, “Bali and Points East.” The dance’s male participants “at times resemble a troupe of cheer leaders made up like Groucho Marx,” noted Williams. “Syncopated movement, swaying forms, flashing fingers, and glittering crowns in high relief against deep shadows under the banyan tree—such is the *djanger*.” —Margaret G. Zackowitz

➤ **Flashback Archive** Find all the photos at [ngm.com](http://ngm.com).

PHOTO: ANDRE ROOSEVELT, NATIONAL GEOGRAPHIC STOCK

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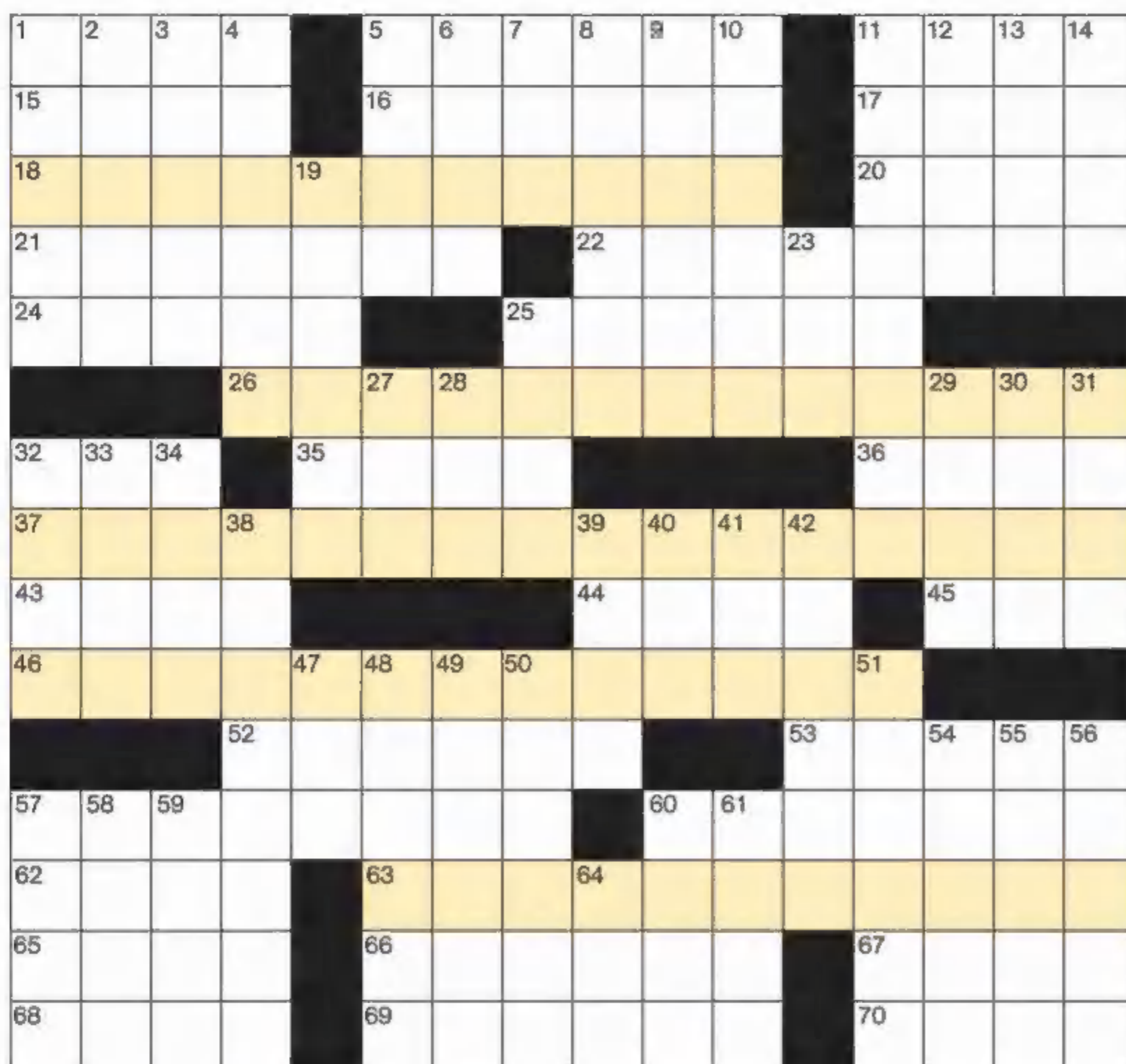


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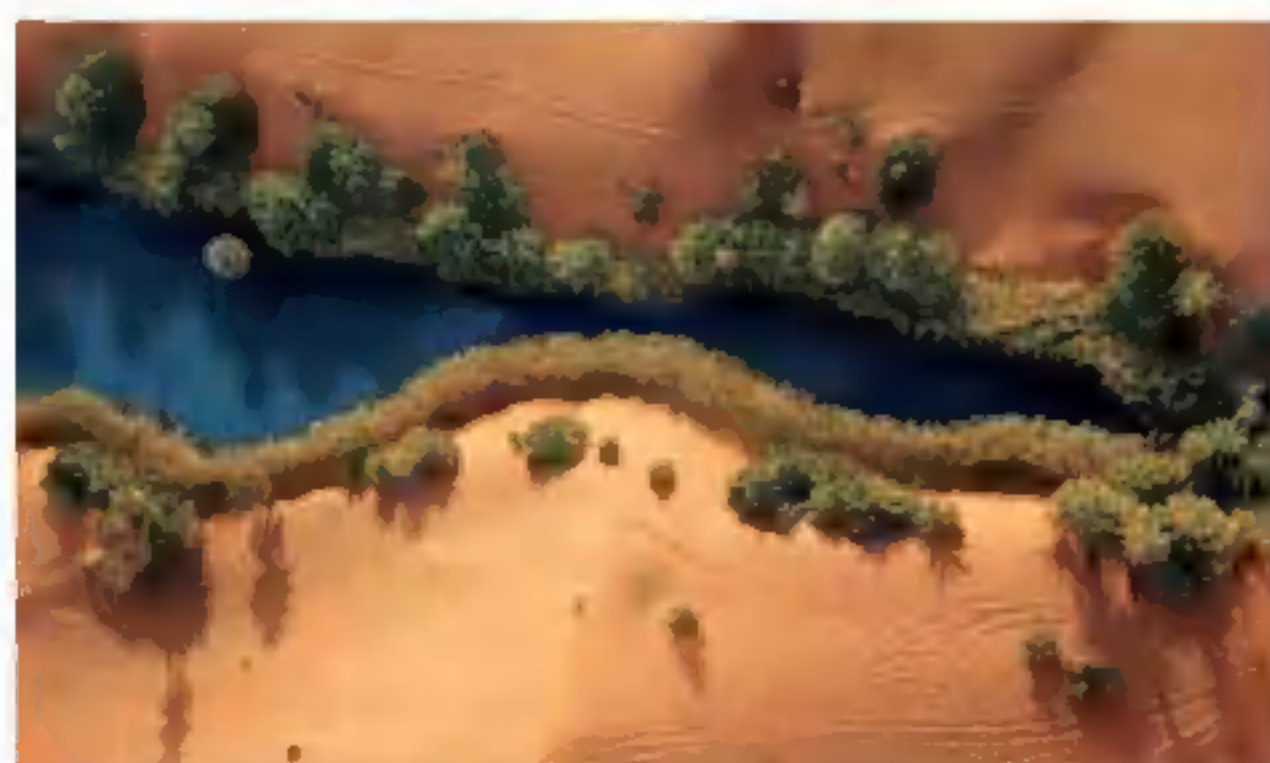


# GEOPUZZLE



## DOWN

- 1 Stravinsky and Sikorsky
- 2 Of yore
- 3 Kol \_\_ (Yom Kippur Eve chant)
- 4 Engross
- 5 Freedom from \_\_ (one of an FDR foursome)
- 6 Our planet, to Planck
- 7 Pre-Christ abbrev.
- 8 Mexican resort city
- 9 Number next to a plus sign
- 10 Botch
- 11 British Prime Minister Benjamin
- 12 It's blown in the winds
- 13 Mojave Desert "monster"
- 14 Temptation location
- 19 Accounting jobs
- 23 Boxer Laila
- 25 Pork product
- 27 Beat \_\_ pulp
- 28 The Sahara's has no mercy
- 29 Gabrielle Chanel, by nickname
- 30 Always
- 31 Zaire's dictator, Mobutu \_\_ Seko
- 32 Ice and space, e.g.
- 33 Snapshot, in commercial usage
- 34 College mil. program
- 38 Domains of high-ranking nobles
- 39 Unwelcome freshness
- 40 Its cap. is Addis Ababa
- 41 Ebro or Tajo, *por ejemplo*
- 42 Swerved
- 47 Gp. that spawned the Weathermen
- 48 Experts
- 49 Kind of acid in fertilizers
- 50 Bygone car named for a conquistador
- 51 Holy havens
- 54 Nosy sort
- 55 Feather, in zoology and Latin
- 56 Fatah founder Arafat
- 57 Kaffiyehs, e.g.
- 58 Light tan tone
- 59 Saharan
- 60 Like TV's Kojak
- 61 Murdered consort of Portugal's Pedro I
- 64 The Cards, cut?



## Clue Grit

Puzzle by Cathy Allis

We hope your ability to solve GeoPuzzle clues is not drying up like the ancient lakes and rivers that spread across the Sahara thousands of years ago but have long since disappeared (see story, page 100). Tinted clues test your skill at desert crosswording.

## ACROSS

- 1 Inner Hebrides island
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- 11 Former Venetian VIP
- 15 Jive talking
- 16 Pinball player's hangout
- 17 Footnote ditto, for short
- 18 Irregular Saharan boundaries?
- 20 Pump part
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- 22 Option for a blessed delivery
- 24 Edgar Bergen's dummy Mortimer

- 25 Crescent-shaped fingernail area
- 26 Nibbled some grains in the Sahara?
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- 35 It may include Saharan camel rides
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- 37 They're helpful for Saharan caravan maintenance?
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- 52 Vortices
- 53 Like Rod Stewart's voice
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- 60 Two-year periods
- 62 Prefix meaning "height"
- 63 Masterful Saharan scams?
- 65 Add to or remove
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- 67 Nobelist novelist Morrison
- 68 Froth
- 69 Dresses down
- 70 On \_\_ with (equal to)

Answers in  
*Inside Geographic*



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# What happened when New Jersey teenagers had to wait a year longer to drive?



MORE OF THEM LIVED TO TALK ABOUT IT.



New Jersey strengthened its Graduated Driver Licensing (GDL) laws and has saved lives. By simply raising its driving age from 16 to 17, not only did New Jersey see a dramatic decrease in teen driving deaths, it became one of the least deadly states for teen drivers.

**Allstate believes there's a way to make every turnpike, highway, route and dirt road safer for teens.**

#### SUPPORT THE STANDUP ACT OF 2009

The STANDUP Act\* (H.R. 1895) creates a National Graduated Driver Licensing (GDL) law that limits

nighttime driving, reduces in-car distractions, puts a cap on the number of friends in the car and increases the required hours of training and supervision. **When states have implemented comprehensive GDL programs, the number of fatal crashes among 16-year-old drivers has fallen by almost 40%.**

**Let's make sure that no matter what state a teen calls home, we can all drive through it safely.** Tell your congressional representatives that you support the STANDUP Act of 2009. **Go to [allstate.com/STANDUP](http://allstate.com/STANDUP).**

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\*The STANDUP Act is the Safe Teen And Novice Driver Uniform Protection Act of 2009.

Sources: IIHS Wheels Weekly, 2008; Allstate America's Teen Driving Hotspots Study, May 2008; Centers for Disease Control and Prevention, Web-based Injury Statistics Query and Reporting System (WISQARS) [Online] (2008). The Cupped Hands logo is a registered service mark and "That's Allstate's Stand" is a service mark of Allstate Insurance Company, Northbrook, IL, Allstate New Jersey Property and Casualty Insurance Company, Bridgewater, NJ. © 2009 Allstate Insurance Company